Enhancing the Impact of Investments in 'Educational' ICT

Thesis

Abstract

There has been a substantial level of investment in ICT in education over the last thirty years, but it has failed to have a proportionately large impact on learning. The purpose of this research was to identify ways of enhancing the impact of future investments in ICT in education. A proposition about one way to do this emerged from the literature. Empirical examination of this proposition highlighted deficiencies in the model and suggested that developing a framework for describing computer use in education would be a more productive approach. Existing frameworks were examined in the light of the data from the first three case studies, revealing significant weaknesses with them. This analysis resulted in the development of a set of criteria for evaluating frameworks for describing computer use in education. A new framework, the Computer Practice Framework (CPF), was then devised, based on key dimensions evident within the first three case studies. The CPF was evaluated against the criteria through further fieldwork in schools and higher education. This led to the refinement of the CPF and indicated that using it as a conceptual framework for thinking about computer use in education could help to create shared visions of the purposes underpinning investments in computer use in education. Using the CPF to support vision building, school development, curriculum planning, communication and shared understandings can enhance the likelihood of such investments having their intended impacts. The development of the CPF thus represents an original contribution to the field, which has the potential to enhance the impact of investments in ICT in education.

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Glossary

CPF	**Computer Practice Framework** The framework developed as part of this research.
DES	**Department of Education and Science** Name given to the UK governments education department up to 1992
DFE	**Department** for Education Name given to the UK governments education department in 1993
DfEE	**Department for Education and the Environment** Name given to the UK governments education department in 1997
DfES	**Department for Education and Skills** Name given to the UK governments education department from 2001
ICT	**Information Communications Technology** Term used to refer to using IT to support learning across the curriculum until 2000, when it became the name given to the subject that had previously been called IT within the English National Curriculum.
IT	**Information Technology** Term used to refer to the English National Curriculum Subject up until 2000 when the subject was renamed ICT, thus blurring the distinction between learning about the technology and using the technology to support learning in other 'subjects'. IT is used within the Focus dimension of the Computer Practice Framework to refer specifically to learning how to operate IT resources, including software.

Throughout this thesis the terminology used corresponds to the terminology that was in use at the time that the research that is being reported took place.

Chapter 1
Introducing the problem

Introduction

At the beginning of the 21st century there is a growing call for a moratorium on ICT expenditure in schools (e.g. Stoll 2000; Cuban 2001). One of the drivers underpinning this is a recognition that despite substantial investment (Twining 2002a) the impact of ICT on teaching and learning has been patchy at best:

> Despite the hyperbole that has continually surrounded the area of educational computing, for the last 20 years the computer has noticeably failed to permeate the school setting.
>
> (Selwyn 1999 p.77)

Trend, Davies and Loveless (1999) describe this difference between the claims made for ICT and its impact on education as a 'reality-rhetoric gap'. There is substantial support in the literature for the view that such a gap exists (e.g. Bonnett 1997; Chalkey and Nicholas 1997; Lemke and Coughlin 1998; Miller and Olson 1999; McFarlane, Harrison, Somekh, Scrimshaw, Harrison and Lewin 2000; Mumtaz 2000; Barton 2001; Cuban 2001; Somekh, Barnes, Triggs, Sutherland, Passey, Holt, Harrison, Fisher, Joyes and Scott 2001; Twining 2001b; Warschauer 2001). Despite this there is still a widely held belief that ICT has the potential to enhance education (e.g. Kent and McNergney 1999; McFarlane *et al*. 2000; BECTa 2001b; DfES 2002; Resnick 2002).

Some proponents of ICT in education argue that the lack of impact of ICT on learning is due to the fact that ICT leads to the development of a different set of learning outcomes to those tested by traditional measures (e.g. Jones, Valdez, Nowakowski and Rasmussen 1994; Taylor and Laurillard 1995; Kent and McNergney 1999; Dede 2000; DiSessa 2000; Heppell 2000; McFarlane *et al.* 2000; ICTRN 2001; Trilling and Hood 2001). For example, McFarlane (1997) argues that current assessment systems, because they rely on testing pupils' ability to memorise information, misjudge the impact of ICT on learning. In a similar vein, Twining and Richards (1999) argue that in order to assess learning involving ICT one needs to examine both the processes and products of learning. Even where current assessment systems do address skills, they often misrepresent the impact of ICT because effective use of ICT emphasises skills, such as collaboration, which are not measured by traditional assessment procedures (Venezky 2001). Heppell (1994) provides an analogy, which illustrates the problem:

> Imagine a nation of horse riders with a clearly defined set of riding capabilities. In one short decade the motor car is invented and within that same decade many children become highly competent drivers extending the boundaries of their travel as well as developing entirely new leisure pursuits (like stock-car racing and hot rodding). At the end of the decade government ministers want to assess the true impact of automobiles on the nation's capability. They do it by putting everyone back on the horses and checking their dressage, jumping and trotting as before. Of course, we can all see that it is ridiculous,
>
> (p.154)

A recognition of this problem has led to calls for better ways of assessing the impact of ICT on learning (e.g. Kaiser 1974; Lemke and Coughlin 1998; Lewin, Scrimshaw, Harrison, Somekh and McFarlane 2000; McFarlane *et al*. 2000; Barton 2001; ICTRN 2001). However, there is overwhelming evidence that ICT is not being used extensively and/or effectively across the curriculum in the majority of schools (e.g. Chalkey and Nicholas 1997; Selwyn and Bullon 2000; BECTa 2001a; Cuban 2001; HMI 2001; OFSTED 2001; Somekh *et al*. 2001; OFSTED 2002b; 2002c; Reynolds 2002). Even where ICT is being used in other subjects the focus is often still on learning ICT skills rather than using ICT to enhance learning of the subject (Somekh *et al*. 2001). Given that this is the case ICT cannot be having a substantial positive impact on learning across the curriculum in the majority of schools, irrespective of the measure of learning that is used.

Recent evidence suggests that in English schools children's achievement in learning about ICT also continues to be unsatisfactory for a large number of pupils (OFSTED 2002b;

2002c; 2002a). This pattern seems to be similar to that in other countries, based on Pelgrum's (2001) report of a survey of primary and lower secondary schools in 26 countries, which shows that the overall level of pupils' ICT skills is not high. Thus, even in the area of learning about ICT itself the substantial level of investment in educational technology seems to have had less impact than had been predicted.

This situation, in which substantial sums of money are being invested in ICT in education but are not having an equally substantial impact in schools, is not sustainable. In order to justify continuing to invest heavily in ICT in schools evidence needs to be found of ICT's effectiveness (Underwood and Underwood 1997; Kennewell 2001) and ways need to be found to increase the impact of those investments.

This thesis explores ways of enhancing the impact of investments in ICT in schools and presents a conceptual framework, called the Computer Practice Framework (CPF), which can help those involved in education to think more clearly about their use of ICT. In so doing the CPF can inform decisions about investments in ICT in education and can help ensure that those investments achieve their intended goals.

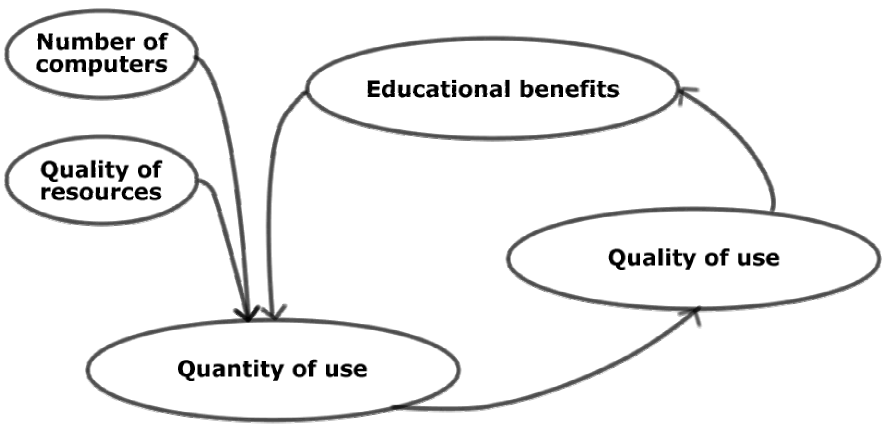
Overview

The structure of the thesis follows the evolution of this research as it developed over time. The exception to this being Chapter 2, which provides a methodological framework for the research as a whole and explores the ways in which the research strategies and methods changed as the focus of the research evolved.

The starting point for the research was a recognition that, despite substantial levels of investment, computers were not being used extensively in schools. This highlighted the need to find ways of increasing the impact of investments in ICT in schools. A literature review was thus carried out in order to identify key factors impacting on the level of computer use in schools (Chapter 1). This review encompassed the field of educational change in general as well as the specific area of computer innovation. It highlighted a number of core variables linked with the level of computer use in schools. Closer examination of the inter-relationships between these variables led to the formulation of the proposition that increasing the quantity and quality of resources would lead to sustained changes in the quantity and quality of computer use. Specifically, the proposition was that:

- increasing the quantity and quality of resources,
  - by adding high quality portable computers with an integrated software suite
  - in sufficient numbers to ensure that a whole group of children could use them simultaneously,
- would lead to an increase in the quantity of computer use,
- which would lead to an increase in the quality of computer use,
- leading in turn to increased educational benefits and still greater use (see Figure 1.1).

Figure 1.1 A pictorial representation of the proposition that increasing the quantity and quality of resources would increase the quantity and quality of computer use



Methodological issues were then examined, in order to determine the most appropriate techniques for exploring this proposition, as well as to inform subsequent stages in the research. Questions relating to methodology were explored at a philosophical level as well as in terms of the pragmatics of conducting this research (Chapter 2). Exploring issues at the philosophical level helped to clarify apparent conflicts between the use of quantitative and qualitative research methods within an interpretivist approach. The use of case studies was identified as being most appropriate in contexts where understanding of causal relationships, subtle distinctions and/or rich descriptions of practice were important. Where the research question placed a greater emphasis on the comparison of data from a larger number of sources than the use of case studies would have allowed questionnaires and focus groups were used.

The proposition identified in Chapter 1 was converted into three related hypotheses, which were tested in three case studies spanning one academic year (Chapter 3). The first hypothesis, that the quantity of computer use would increase with the addition of five high quality portable computers with one integrated software suite, was found to be too simplistic. Other factors were also found to play an important role in determining the quantity of computer use. The second hypothesis, that increases in the quantity of computer use would be associated with increases in the quality of computer use, was also found to be problematic. The third hypothesis, that increases in the quality of computer use would be associated with further increases in the quantity of computer use, was disproved. Thus, the outcome of this testing was that the hypotheses were refuted and the proposition on which they were based was found to be flawed.

The case studies provided rich data about the ways in which computers were used. The analysis of those data, in order to examine the hypothesis, highlighted limitations of the criteria that were used for determining the quality of computer use. It was clear that the quality criteria had been value laden in a way that raised doubts about the quality judgements based upon them. This, combined with further reflection on the literature, highlighted the need for better ways of describing and comparing computer use in education. The rationale being that identifying changes in computer use required having a way of describing computer use in different contexts so that one could compare them in order to see if the computer use had changed. One needed to be able to identify any changes in computer use that were taking place as a precursor to being able to identify the factors that lead to (or inhibited) changes in computer use.

The research thus altered its focus in order to explore ways of describing computer use. This initially involved an analysis of a number of existing frameworks for thinking about computer use in education (Chapter 4). A large number of different frameworks were identified. These were classified as fitting into one of three types: software frameworks; pedagogical frameworks; and evolutionary frameworks. Representative examples of each type of framework were applied to data from the first three case studies. This exercise revealed a number of limitations with the existing frameworks for describing computer use, which were used to develop a set of criteria for the evaluation of such frameworks. The shortcomings of the existing frameworks highlighted the need to develop a new framework for describing computer use in education, as a first step to enhancing the impact of investments in ICT in education.

In order to develop a new framework, which was called the Computer Practice Framework (CPF), the data from the first three case studies were re-analysed (Chapter 5). This highlighted three core dimensions along which the computer use in the three case studies varied. The CPF thus consisted of three complementary dimensions, the Quantity, Focus and Mode. The Quantity dealt with the amount of computer use. The Focus addressed the reasons underpinning the computer use, and the Mode related to the ways in which the computer use was implemented.

The CPF was evaluated against the criteria that had been developed from the application of existing frameworks to data from the first three case studies. This provided support for the view that the CPF overcame many of the problems associated with previous frameworks. It also suggested ways in which the CPF could be enhanced, and highlighted the need for further fieldwork in order to evaluate the CPF more fully. Throughout the subsequent testing and development of the CPF reflection and peer review played an important part in refining its dimensions, and complemented the case studies and questionnaires.

Following the initial development and evaluation of the CPF two new case studies were undertaken to provide a more rigorous test of the CPF (Chapter 6). In addition a questionnaire was distributed to academics working in higher education in order to explore the extent to which the CPF could be applied in as wide a range as possible of different educational contexts. This further fieldwork provided additional evidence of the value of the CPF, whilst also suggesting a number of ways in which it could be enhanced. However, it also raised crucial questions about the reliability and validity of the CPF as a framework for describing computer use.

A sixth case study was planned in order to test the reliability and validity of the CPF (Chapter 7). Whilst this case study was being organised a focus group was held with colleagues from the Association for IT in Teacher Education. The focus group resulted in further refinements to the CPF and confirmed the need for further testing of its reliability and validity. The sixth case study was designed to serve two key aims: firstly, to provide evidence about the reliability and validity of the CPF; and secondly, to provide 'raw data' that could be used in subsequent testing of the inter-operator reliability of the CPF. In analysing the data from this case study it became clear that the researcher and the teacher were not applying the Focus and Mode dimensions of the CPF in the same way. This suggested that it was not reliable. Further work on Case Study 6 to explore the validity of the CPF was therefore suspended, whilst its inter-operator reliability was explored in more depth.

Having made additional changes to the CPF, in the light of the experiences of using it in Case Study 6 and from peer review, the extent to which the CPF could be applied reliably by a number of different observers was tested. This involved providing 27 colleagues from the Association for IT in Teacher Education with sets of material that provided 'rich descriptions' of computer use, which they were asked to analyse using the CPF. The outcomes from this testing raised further questions about the reliability of the CPF. However, it was clear from the responses that at least some of the differences between the responses were due to confusion about how to apply the CPF. The CPF was revised to overcome these problems. However, in the process of doing this it became clear that using the CPF as a conceptual tool for thinking about computer use, rather than as a framework for describing use that had already taken place, would make it a much more powerful tool for enhancing the impact of investments in ICT in education.

The problem

In the early 1990s computers were widely seen as being important to education. Pelgrum and Plomp (1991) identified seven reasons why computers might be important to schools. These included rationales relating to social and economic interests, such as reducing the costs of education, supporting the computer industry, preparing students for work and for living in a society permeated with technology, and making the school more attractive to its potential clients. They also included educational drivers, such as acting as a catalyst to speed up the process of educational change, and improving learning processes and outcomes. There was particularly widespread support in the literature for the view that computers could enhance learning (e.g. Niemiec and Walburg 1992; Heppell 1993b; NCET 1993), particularly if used as a cross-curricular tool (e.g. DES 1989; ILECAS 1989; NCC 1990; Hadley and Sheingold 1993; Watson 1993).

Associated with this belief in the importance of computers to education had been a high level of investment in new technology, starting in the early 1970s. The estimated government funding for IT programmes in education had cost £30million by 1983 (Thomas 1992). This pattern of significant investment continued throughout the 1980s and into the 1990s. Whilst some of this investment was not limited to the school level, the figures quoted here under-represent the overall sums invested in computers in schools because much of that investment was not explicitly identified in separate budgets.

Figures from the UK government's statistical branch surveys of IT in schools, which go back to 1985, provide a clear picture of the level of investment. These data were based on postal surveys, which were sent to head teachers in hundreds of 'representative' schools throughout England. Figures 1.2 and 1.3 are based on data from these surveys.

Figure 1.2 shows the level of expenditure on IT in primary and secondary schools in England rising from the low millions in 1985 to tens of millions of pounds per year in 1992. This investment amounted to over £200million being spent on IT in English state schools between 1985 and 1992.

Figure 1.2 Estimated expenditure on ICT in English state schools (DFE 1993)

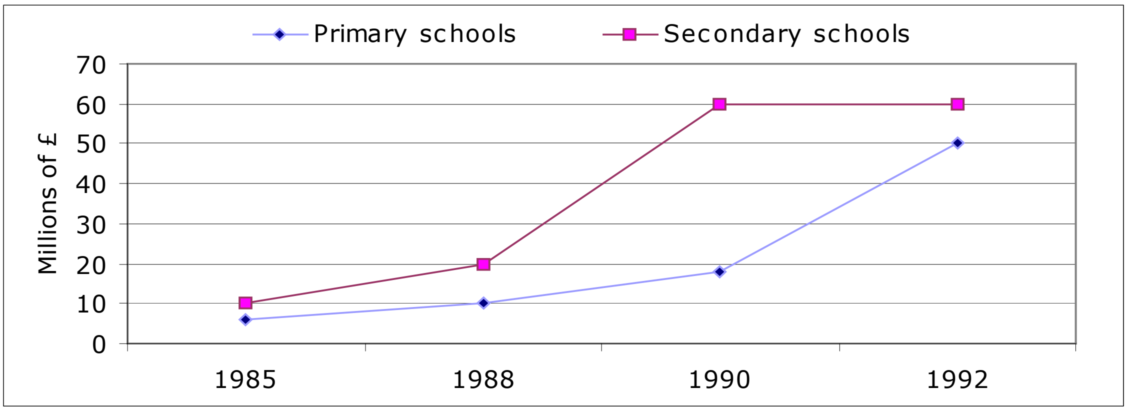
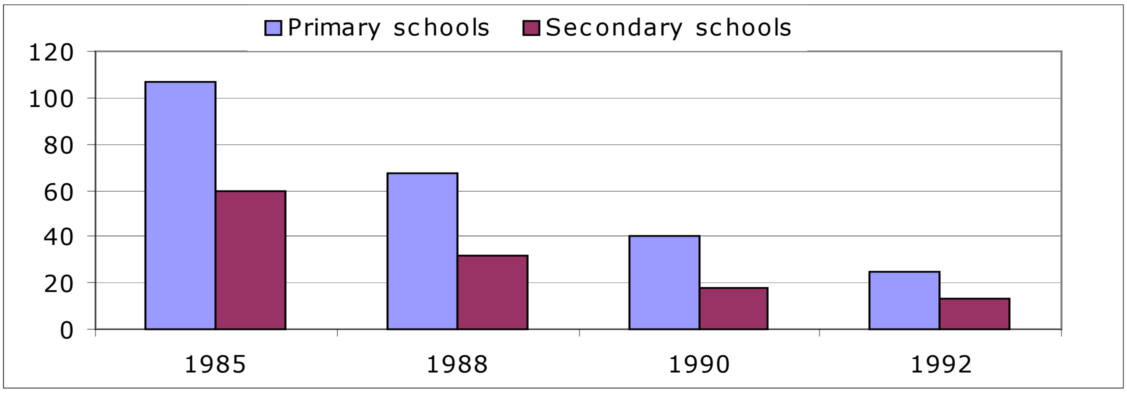


Figure 1.3 shows that the number of students per computer decreased significantly between 1985 and 1992. In looking at these figures it is important to remember that computers have a limited 'useful' working life. This means that maintaining the same student:computer ratio requires investment. As the student:computer ratio improves the amount of investment needed to maintain that student:computer ratio also increases. This helps to explain the slowing down in the rate of improvement of the student:computer ratio in Figure 1.3.

Figure 1.3 Average number of pupils per computer in English state schools (DFE 1993)



Thus, there had been a high level of investment in computers in schools and there was extensive support in the literature for the view that computers could enhance learning. Despite this, there was little evidence of computers having had the impact that their proponents had claimed. Indeed, the literature provided extensive support for the view that both the quantity and quality of computer use in schools was low (e.g. Plomp, Pelgrum and Steerneman 1990; Rhodes and Cox 1990; Kerr 1991; Cuban 1993; Hadley and Sheingold 1993; Watson 1993). This situation was clearly unsatisfactory. Ways needed to be found to enhance the impact of investments in educational IT. This is the focus of the thesis.

Understanding the reasons for this low level of computer use appeared to be the key to increasing the impact of investments in computers in schools. Thus, the initial question that needed to be addressed was how to increase the quantity and quality of computer use in schools. Identifying key variables impacting on the quantity and quality of computer use in schools was a necessary first step to answering this question. A review was thus carried out of the relevant literature that was available at the time.

The Literature review

This review, whilst specifically concerned with computer use in schools, looked at the literature on computer innovation as well as the general literature on educational change. It also spanned all phases of education, on the basis that issues for each phase have relevance for the others (Grunberg and Summers 1992). However, in so doing, differences between the phases, such as their size, organisation, the complexity of content taught and the degree of pedagogical variability (Cuban 1993) were borne in mind. Similarly, dangers in assuming that 'educational change' could be viewed as a general phenomenon, irrespective of the scale, unit of analysis, and so forth (Fullan and Stiegelbauer 1991) were recognised. Indeed, it was clear from an initial analysis of the literature that "there is no one general solution that is applicable to all schools" (Zammit 1992 p.64) and that "The number and dynamics of factors that interact and affect the process of educational change are too overwhelming to compute in anything resembling a fully determined way." (Fullan and Stiegelbauer 1991 p.47).

A number of different ways of categorising the factors involved in educational change had been suggested in the literature. These typically focused on three levels, involving factors relating to: the innovation itself; the local context in which the change is being considered; and the wider context (see Table 1.1 for examples). The PALM Project (Somekh 1989b) used a simpler classification, with only two main categories: institutional barriers; and personal barriers.

Table 1.1 Examples of categorisations of factors

Level \ Source	Huberman (1973)	Pelgrum and Plomp (1991)	Fullan (1992)
Innovation itself	Inherent or intrinsic variables	Innovation characteristics	Characteristics of the change
Local context	Situational variables	School organization	Local characteristics
Wider context	Environmental variables	National context External support	External factors

Each of these classifications, at least superficially, appeared to suffer from the problem that Maddux (1993) identified, namely an absence of attention to learner or teaching variables. To overcome this, the variables in this review are categorised under the headings: personal factors; institutional factors; and pedagogical factors. During the course of the review the importance of 'vision building' as an overarching theme emerged, and so a fourth category was added to the review.

Personal factors

In their survey of 1200 'effective users' of ICT across the USA Hadley and Sheingold (1993) asked the users to rate 35 possible barriers to computer use. A factor analysis of over 600 responses found that seven themes accounted for over 50% of variance in the answers. One of these related to personal factors: "Teacher's doubts, lack of interest or knowledge about computers" (Hadley and Sheingold 1993 p.283). This reflected the three sets of inter-related personal factors in the literature: attitudinal and/or motivational issues; lack of confidence and/or competence; and ownership.

Teachers' lack of interest in using computers was one of the seven most highly rated barriers in Hadley and Sheingold's survey (1993). This confirmed the importance of teachers' attitudes, which had been reported by numerous other studies (Rhodes and Cox 1990). Linked with teachers' attitudes were issues relating to their motivation and commitment, from both the general literature on educational change (e.g. Preedy and Wallace 1993) and the literature on computer innovation in education (e.g. Rhodes and Cox 1990).

A number of different underlying motives for using computers was evident in the literature, including self-motivation to keep up to date (Zammit 1992) and a desire to harness the motivating factor of computers for children (Hall and Rhodes 1986). Both of these were confirmed as being key factors by Hadley and Sheingold (1993), who noted that "the teachers' motivation and commitment to their students' learning and to their own development as teachers" stood out as one of three key factors in their use of computers (p.298).

Bliss, Chandra and Cox (1986), in their case study involving 15 secondary school teachers, found that even where teachers were positive about using computers in schools they often had serious worries or criticisms about their use. These included anxieties about the time and energy needed to use them, which are explored under institutional and pedagogical factors below, as well as about their own inadequacy. Blease and Cohen's (1990) ethnographic study of two teachers in a primary school in England confirmed earlier work by Heywood and Norman (1988) that "the major cause of reluctance and concern is to do with a lack of confidence and competence" (Blease and Cohen 1990 p.29).

The importance of teachers' confidence as a variable impacting on computer use is commonly reported in the literature (e.g. Ellis 1986; Somekh 1989a; Rhodes and Cox 1990; Seaborne 1993). Somekh (1989a; 1989b) identified a problem with teachers' self-images as being non-technical, which impacted on their confidence in using the technology *per se*. Teachers' confidence also related to their perceptions of their ability to use computers in the classroom, particularly in relation to their children's perceived competence: "A major part of the confidence problem of teachers was related to the fact that they felt less competent than some students in using computers." (Grunberg and Summers 1992 p.269). This impacted on what Somekh (1989b) referred to as their 'professional confidence'.

The issue of confidence has clear links with competence, which Gross, Giacquinta and Bernstein (1971) had identified as being one of the five barriers to innovation. This view was confirmed by Pelgrum and Plomp's (1991) survey of computer use in 20 education systems world-wide, and by Seaborne (1993) when he identified that "Teachers are being expected to develop ideas which are racing ahead of what they know and have learned to teach." (p.16) and argued for the need to "enable all teachers to pass through the 'pain' threshold to confidence with IT" (p.17). This suggested a number of different forms of knowledge, skills and understanding that teachers need to have in order to use computers effectively in education. These included competence in teaching *per se*, the technical skills required in order to operate a computer and an understanding of how to use computers in the classroom. Limitations in all three of these areas of competence were identified in the literature as being barriers to computer use.

McCoy & Haggard's (1989) survey of 112 teachers in 26 US schools looked at a range of possible factors that might impact on computer use. These included: the teacher's gender; the age of children taught; how long the teacher had taught for; the teacher's confidence in operating a computer; and the teacher's view of the value of computers in education. They found that the only variable that was significant in predicting the amount of computer use was the length of time the teacher had been teaching. Other authors do not support this finding, although some agree that teaching experience and/or competence in teaching *per se* is a contributory factor. For example, Seaborne (1993) claimed that "some of the limitations of progress in respect of IT in schools were to do with teachers' general skills and teaching abilities" (p.16) and went on to specifically identify their intervention skills as being important.

A number of sources noted a lack of technical competence as being an important barrier to computer use in schools (e.g. Heywood and Norman 1988; Somekh 1989a; Seaborne 1993). Hadley and Sheingold (1993) identified this as one of the seven most highly rated barriers. This lack of knowledge about how to operate the technology linked with technical failures led to what the PALM Project (Somekh 1989b) called technical frustration and identified as being one of 10 major barriers to computer use in schools.

A number of authors also identified teachers' lack of understanding of how to use computers in their classrooms as being an important barrier to computer use. For example, Heywood and Norman (1988) stated that teachers lacked the competence to see how to integrate computers within the existing curriculum. Sheingold, Kane and Endreweit (1983) in their studies of 27 schools spanning elementary to senior high level, highlighted the need for further research on the integration of microcomputers into elementary classrooms and curricula. This reflected their findings about the lack of understanding teachers felt they had for using computers in their classrooms. Seaborne (1993) commented that teachers' (mis-)belief that computers are 'self-instructional', which was one facet of their lack of understanding of how to integrate computers into their classrooms, was another barrier to computer use. The PALM Project (Somekh 1989a; 1989b) agreed that a lack of understanding of how to use computers was a significant barrier. She went on to say that "teachers may be unable to imagine uses for the computer without first using it with children, and paradoxically, as professionals, they may wish to see a purpose for using the computer before using it with children" (Somekh 1989a p.21). This is one facet of a need for ownership of innovations that is commonly reported in the change literature.

Fullan (1992) identified ownership as being an 'overriding problem' in any change process. This was perhaps not surprising given that change involves learning (Fullan and Stiegelbauer 1991) and personal ownership is a key component of learning (Papert 1980; 1994). Lack of ownership was highlighted as being a barrier to effective change in schools and colleges (Preedy and Wallace 1993) and to computer innovation in schools (Watson 1991). Rhodes (1989) confirmed the importance of ownership, and noted that teachers' perceptions that computers had been imposed upon them amplified their feelings of lack of ownership. She argued that teachers needed to build their own meanings surrounding computer use. Gillman (1989) confirmed the importance of teachers' participation in the decision making process, in his metasynthesis of research on computer use in schools. This echoed aspects of the earlier work of Blumenfeld, Hirschbul and Rubaiy (1979), which usefully highlighted the importance of social-cultural issues relating to computer use. These barriers included characteristics of the innovator and recipients, methods of communication used, participation of recipients, the needs of the recipient, and a number of other institutional factors.

Institutional factors

Institutional factors are set in a wider institutional context. Fullan and Stiegelbauer (1991) point out that complex change is multilevel and is often dependent upon "the strategies and supports offered by the larger organization" (p.73). This is the case even where 'the unit of change' is the school. Thus, many of the constraints identified in the literature, whilst impacting at the school level, are in the control of higher levels of the organisation of the education system. For example Pelgrum and Plomp (1991) highlighted lack of long term 'security' of funding (buying and maintenance of equipment/software) as being a key inhibitor to the uptake of computers in schools.

Organisational constraints are commonly cited as being a major barrier to change (e.g. Gross *et al.* 1971; Plomp *et al.* 1990). At the school level these may be physical, for example relating to the fabric of the building (Rhodes and Cox 1990) or logistical, for example including such things as timetabling arrangements (e.g. Chandra 1986; Rhodes and Cox 1990), class size (Chandra 1986) and the proportion of statemented children (Atkinson 1993). Somekh (1989b) identified logistical problems as being a major barrier to computer use. These included institutional rules as well as more mundane problems such as a lack of consumables (Somekh 1989a).

Overcoming organisational constraints calls for a whole school perspective (High 1988), which encompasses the following key themes, which Fullan (1992) recognised as being important when implementing change: vision building; initiative taking and empowerment; staff development and resource assistance; restructuring; monitoring/problem solving; and evolutionary planning.

Management underpins many of Fullan's (1992) key themes, and is widely cited in the literature as being of major importance to successful innovation. This applies across all institutional levels. For example, Plomp *et al.* (1990) found that one of the barriers to computer use in their three case study schools was a lack of direction from the administration at school and national level. Hearst (1982) had previously reported that the evaluation of the Scottish Microelectronics Development Programme had found that poor communication between schools and the outside agencies who were supporting them was one of the main problems inhibiting computer use in Scottish schools.

Huberman (1973) also indicated the importance of leadership and sponsorship, to which he also added the need for incentives and rewards. Fullan (1992) re-framed this as a need for pressure and support. Preedy and Wallace (1993) identified the need for there to be a critical mass of support, both internal to the organisation as well as from external sources. This view confirmed Dwyer, Ringstaff and Sandholtz's (1990) finding that support was needed from both colleagues and administrators. They argued that support needed to take different forms for teachers who were at different stages in the process of implementing computer use in their classrooms. Hadley and Sheingold (1993) noted that administrative support, technical support and encouragement were all important. This highlighted the importance of having adequate support structures (Rhodes 1989) and computer co-ordination (Pelgrum and Plomp 1991). Lack of support from leaders was a key obstacle to successful integration of computers in education (Blumenfeld *et al.* 1979; Pelgrum and Plomp 1991). However, even where such support existed for an innovation from people in leadership roles it did not carry any weight unless that support was demonstrated through action (Fullan and Stiegelbauer 1991).

Within the context of a school the head plays a fundamental role in providing such leadership: "The principal strongly influences the likelihood of change," (Fullan and Stiegelbauer 1991 p.76). Cox, Rhodes and Hall (1988) stated it more strongly, saying that the role of the head was crucial in the case of computer use in primary schools, which was why they found the attitude of the head towards technology was so important. Shiman and Lieberman (1974) had previously noted the importance of the principal's leadership style in the success of educational change. Fullan and Stiegelbauer (1991) found that heads generally did not function well as change agents; a view that was supported by Bell (1993a; 1993b), who identified a lack of 'a strategic management of change approach' as being one of eight barriers to 'the full exploitation of IT in learning'. Such a strategic approach would involve the integration of computer use with the school's development policy, which Rhodes (1989) identified as being a contributory factor to successful computer uptake in primary schools in some of the research she reviewed.

Not withstanding the critical involvement of the head in successful change initiatives, other staff also play key roles. For example, Rhodes and Cox (1990) and Zammit (1992) noted the importance of having a teacher with overall responsibility for computers. Perhaps more fundamentally, Fullan and Stiegelbaur (1991) stated that in practice "the main agents (or blockers) of change are the principals and teachers" (p.76). This is important not only at the level of individuals, who may or may not use computers within their own teaching, but also in terms of the overall culture of the institution.

Shiman and Lieberman (1974) highlighted the importance of institutional culture and group norms in any curricular, organizational or instructional change. Pelgrum and Plomp (1991) identified a negative school climate, lacking in collegiality as one of the obstacles to successful integration of computers in education. This provided support for the evaluation of the Scottish Microelectronics Development Programme which found that one of the main problems inhibiting computer use was a sense of isolation by the teachers (Hearst 1982). In schools, where fitting in with group norms is felt to be important (Huberman 1973), it is understandable that if using computers makes you feel isolated from the group you are less likely to use them. This helped to explain why the resistance of colleagues to computers inhibited computer use in schools (Plomp *et al.* 1990).

The importance of teachers feeling that they were part of a group was seen as a key factor in computer use by Hadley and Sheingold (1993). They described the sense of support and collegiality that this engendered in their teachers. This confirmed the importance of teachers sharing of expertise, which Rhodes (1989) identified as being a key factor in computer use in schools. Fullan and Stiegelbauer (1991) had also emphasised that the "quality of working relationships among teachers is strongly related to implementation." (p.77). This was perhaps not surprising given that "Change involves learning to do something new, and interaction is the primary basis for social learning." (p.77).

This identification of change as a learning process fitted with Hadley and Sheingold's (1993) view that for computer use to become more widespread there needed to be "a school structure and culture in which teachers are encouraged and expected to take a professional and experimental approach to their work." (p.300). However, the literature also clearly identified the need for more and better formal staff development and accompanying support materials.

Fullan (1986) asserted that educational change has three aspects: the use of new or revised materials; the use of new skills and behaviour; and changes in beliefs and understanding. He argued that significant educational change must include the latter two and that this was why effective professional development was essential if effective change was to take place. He went on to emphasise the importance of the school culture in enhancing professional development, which he saw as including both formal and informal learning experiences.

The importance of training with respect to computer use in schools was almost universally acknowledged within the literature (e.g. Sheingold *et al.* 1983; Chandra 1986; Ellis 1986; Hall and Rhodes 1986; Rhodes 1989; Plomp *et al.* 1990; Pelgrum and Plomp 1991; Zammit 1992). This related to both initial teacher training and in-service provision.

Kerr (1991) identified a number of strategies for improving the use of IT in teaching by improving the way it was introduced in teacher education programmes. For example, he advocated providing role models for trainee teachers through the lecturers' use of technology, as well as giving student teachers time to overcome their fears of the technology through their own use of it. He argued that they should be encouraged to be reflective, to take risks and to learn from their mistakes. He reasoned that by focussing on one application, such as word processing, rather than tackling several in quick succession student teachers would be more likely to achieve success. None the less he recognised that they needed to move slowly and he highlighted the importance of maintaining a focus on meeting the needs of the children who they would be teaching.

Kerr (1991) recognised the value of developing teachers' competence with IT before they used it with children. Somekh (1989a) agreed that this was important, and criticised the lack of training in computer use available for practising teachers, saying that "teachers are expected to learn how to use computers in the classroom, alongside the children" (p.21). Watson (1991) identified current in-service training as being inadequate and went on to recommend that every teacher should have five days training on computer use per year.

Other researchers identified the inadequacy of INSET in terms of its quality as well as its duration.

Pelgrum and Plomp (1991) criticised the tendency for INSET to focus on technology rather than on how to integrate it into the classroom or how to evaluate and select software. This linked with a "lack of understanding of the personal challenge involved in beginning to use computers" (Somekh 1989a p.22) and often with a 'deficit model' of teachers (Rhodes 1989). Rhodes (1989) argued that rather than adopting a 'deficit model' in which teachers were viewed as lacking skills which needed to be taught, INSET on computer use should adopt a 'skills model' in which teachers were seen as the experts who need to identify how technology could help them. She argued that this would require a move away from short courses towards long ones.

Cox *et al*. (1988) and Rhodes and Cox (1990) identified that short INSET courses were not effective whereas a developmental approach to computer use and sustained school based INSET was. This view was supported by Plomp *et al*. (1990) who found a need for a "continuous ongoing process of staff development" (p.164) in their case study schools. They went on to say that more effective use needed to be made of external resources, which included materials and training. However, a number of authors had previously identified a lack of guidelines (e.g. Shultz, Morrison and Pruett 1989 cited in Grunberg and Summers 1992) and a need for support materials which meet teachers' concerns (e.g. Brown and McIntyre 1982).

Staff development of the type that the literature seemed to recommend requires time. High (1988) recognised this in advocating reductions in teaching loads for those staff who are involved with INSET. However, this is only a partial solution to the problem of time for teachers to learn how to use computers in their work.

"One of the most difficult organisational and individual problems with the practicality of implementation [of computer use in schools] is the consistently reported need of teachers for time to learn what programs can do and time to plan how they might be used" (Fullan, Miles and Anderson 1987 p.51). This view that teachers needed more time in order to be able to use computers in their teaching received extensive support in the literature (e.g. Brown and McIntyre 1982; Sheingold *et al.* 1983; Chandra 1986; Gillman 1989; Somekh 1989a; Plomp *et al.* 1990; Pelgrum and Plomp 1991; Hadley and Sheingold 1993).

Most of the reported concerns about time as a factor inhibiting computer use in schools related to the teachers' time outside the classroom. However, Schultz *et al*. (1989) found that many teachers who thought computers could improve or assist their teaching still did not use them because they were concerned that using computers would "reduce the already scarce class time available to cover the present curriculum" (cited in Grunberg and Summers 1992 p.268). Whether inside or outside the classroom the key problem in relation to time appeared to be in balancing competing priorities. Zammit's (1992) teachers explicitly highlighted this in terms of having to find time outside school to learn to use computers.

The pressure on teacher's time was highlighted by Kerr (1991) who identified that they lacked time to be reflective and that this in turn could lead to a focus on practical matters to the exclusion of other things. In the context of computer use those practical matters are likely to relate to resource issues.

The issue of resources is a major factor in effective change in schools (Preedy and Wallace 1993) and of particular concern to teachers in relation to computer use (e.g. Brown and McIntyre 1982). This is seen to apply both in terms of the level of resource provision (e.g. Atkinson 1993) and the organisation and management of those resources (e.g. Ellis 1986); the key issue being teachers' perceptions of the availability of resources in terms of their access to them (e.g. Anderson, Hansen, Johnson and Klassen 1979; Gillman 1989).

Anderson *et al.* (1979) in their early investigation to see if social factors as well as technological factors effect the adoption of computers concluded that "slightly over half the explained variance in adoption is accounted for by technological factors (amount and availability of computer resources)" (p.247). However, as Bliss *et al.* (1986) discovered, it seems likely that teachers with different levels of experience in using computers in schools have different concerns about their use. Sandholtz, Ringstaff and Dwyer (1990) found that this was the case in the Apple Classrooms of Tomorrow schools, with the most common concern in the initial stages of computer use being with technical problems which upset teachers' daily and long-range plans. A large number of other studies have reported the quantity of hardware as being an important issue (e.g. Anderson *et al.* 1979; Chandra 1986; Plomp *et al.* 1990; Rhodes and Cox 1990; Pelgrum and Plomp 1991; Hadley and Sheingold 1993).

Keirns (1990) concluded that adding enough machines did change teachers' beliefs and practices. Most experts did not support this view, though they would accept the importance of the level of resource provision. For example, Hearst (1982) suggested that the Scottish Microelectronics Development Programme had overemphasised the importance of the number of machines rather than the use to which they could be put. Similarly, Maddux (1993) stated that "there is obviously some unknown but nevertheless critical, minimal number of machines that must be in schools before even exemplary use can be expected to have a positive effect on teaching and learning" (p.15), whilst at the same time arguing that research needed to move beyond its concentration on technology issues and focus on pedagogical ones. Kerr (1991), who provided five machines per class in his evaluation study, concluded that given enough computers "technology did allow classrooms to be physically transformed in ways that were obvious and dramatic" (p.132). That however, did not refute Bell's (1993a) claim that "increasing resources alone does not necessarily lead to increased effective use" (p.7). None the less, insufficient and/or inappropriate equipment was widely recognised as being one of the most important barriers to effective computer use in schools (e.g. Watson 1991; Hadley and Sheingold 1993).

Anderson *et al.* (1979) reported that "the amount of computer resources in the school has no *direct* effect upon adoption or disadoption" (p.243), however, the perceived availability of those computers was an important predictor. Thus, the key variable may not be the actual availability of resources but teachers' perceptions of their ease of access to them. Many research reports identify lack of access to computer equipment as being an important factor related to the level of computer use in schools (e.g. Sheingold *et al.* 1983; Hall and Rhodes 1986; Olson and Eaton 1986; High 1988; Rhodes 1989; Somekh 1989a; 1989b; Rhodes and Cox 1990; Zammit 1992).

Anderson *et al.* (1979) did find that resource availability and the distance that teachers were from the computers were significant predictors of computer use. Blumenfeld *et al.* (1979) confirmed the finding that the location of computers was an important factor in their use and suggested that the centralisation of computers in a separate room was a barrier to innovation. Ellis (1986) subsequently asserted that computers should be transportable and easily accessible to teachers. Watson (1991) agreed with this view and argued that "the real hardware barrier is ownership. ... Provision of powerful portable computers for teachers could have a significant effect on the use of IT in schools." (p.550). The value of using portable computers was given further support by the PLAIT Project, which concluded that:

> the use of portable computers:
> - is a convenient and accessible method of resourcing the delivery of IT requirements of the statutory curriculum;
> - enhances considerably the IT competence of pupils;
> - enhances work, undertaken both in class and at home, ...
>
> (NCET 1993 p.1)

Birnbaum (NAACE 1992) had previously argued for the importance of portability as one facet of the quality of IT provision. He also argued that there was a need for greater power at less cost and better networking in schools. The issue of quality of resources was found to be an important facet of hardware that impacted on computer use. For example, Ellis (1986) and Olson and Eaton (1986) found technical problems with hardware, such as unreliability, to be a barrier to computer use. Another facet of the quality of equipment mentioned as being a factor in computer use in schools was its ease of use (e.g. Hall and Rhodes 1986; Watson 1991).

The ease of use, or more accurately the complexity of use of hardware was closely linked with problems that the literature identified with 'educational' software. Hall and Rhodes (1986) identified the ease of use of software as being a factor influencing the uptake of computers. Watson (1991) criticised educational software for having too many different user interfaces and no consistent 'look and feel'. He argued that "Use is a function of the accessibility of the software (its user interface) and its conceptual complexity" (Watson 1991 p.550) and that due to the problems he had identified with educational software the learning curve for teachers was too steep. Birnbaum (NAACE 1992) also argued for the need for more intuitive systems and the integration of different information forms. Downes (1990) was also critical of the available educational software at the time, much of which she thought was inappropriate. She argued, in the context of data handling software, that "Rather than fitting the user and task to the existing tools we should begin by closely examining both the learners and their information handling tasks" (p.648).

Numerous other researchers reported that the lack of good educational software was a major barrier to computer use in schools (e.g. Sheingold *et al.* 1983; Bliss *et al.* 1986; Chandra 1986; Olson and Eaton 1986; Plomp *et al.* 1990; Rhodes and Cox 1990; Pelgrum and Plomp 1991; Zammit 1992; Bell 1993a; 1993b; Hadley and Sheingold 1993). Cole (1993) also identified the need for guidelines to help teachers evaluate software.

Some researchers argued that rather than needing more software per se greater emphasis should be placed on the use of computers as cross-curricular tools (e.g. Ellis 1986) and on more participative software learning environments in which children were the originators and presenters of information not just its consumers (Heppell 1993b). Kerr (1991) argued that student teachers should focus on one application first, such as a word processor, in order to minimise the learning curve and maximise their changes of success. Using the computer as a tool also had the advantage, according to Kerr (1991), that teachers could use it inside the classroom with children as well as outside the classroom for their own professional work. This strategy would maximise the time spent using the software and hence the teacher's opportunity to become familiar with it whilst at the same time improving the cost-benefit ratio for learning to use it. Pelgrum and Plomp (1991) highlighted the importance of the personal costs and benefits to teachers of using computers. Maddux (1993) argued that "it is time to expand our concerns to include pedagogical, as well as equipment problems" (p.15) and it was clear from the literature that pedagogical issues played a significant role in any such cost:benefit analysis.

Pedagogical factors

There is widespread consensus within the literature that computer use needs to be integrated into the classroom and curriculum (e.g. Sheingold *et al.* 1983). Seaborne (1993) argued that this needed to go beyond bolting IT onto the existing curriculum and there was a need to "look at how IT materially affects the learning process, rather than to focus solely on how you integrate it in the curriculum or learn about it" (p.17). Many sources agreed with this position and identified that "there must be a willingness to change traditional approaches to learning and teaching." (Bell 1993a p.6). However, there was also widespread recognition that this was not straightforward. For example, Olson and Eaton (1986) found that routine procedures which fitted with existing teaching routines were easier to implement than novel ones which did not fit with familiar routines.

Cuban (1988) subsequently described two different magnitudes of change, which he labelled 'First-order' and 'Second-order' change. First-order change tries "to make what already exists more efficient and more effective, without disturbing the basic organizational features, without substantially altering the ways in which adults and children perform their roles." (p.342). Second-order change on the other hand, seeks "to alter the fundamental ways in which organizations are put together" by introducing "new goals, structures, and roles that transform familiar ways of doing things into new ways of solving persistent problems." (p.342).

Cuban (1988) argued that for second-order change to take place "*basic social and political changes would need to occur outside of schools*" (p.344). His analysis of three decades of 'school reform' in the USA found "first-order changes succeeded while second-order changes were either adapted to fit what existed or sloughed off, allowing the system to remain essentially untouched" (p.343). This corresponded with Huberman and Miles'

(1984) description of teachers 'downsizing' changes, effectively moving second-order to first-order changes, by only taking on board aspects that fitted their personal style of teaching. Similarly, Crook (1989) in his longitudinal study in UK primary education found that "too often the computer may also be fractured from a mainstream activity within even its own classroom" (p.20).

Kerr (1991) identified two key areas that were important in understanding this lack of impact of computers on education in schools, which he described as "the general place of technology in teachers' thinking about their craft," and "changes in classroom organization and practice that flow from incorporating technology." (p.123).

There was widespread agreement in the literature that conceptions of teaching were a fundamental obstacle to the integration of computers into schools. These were what Cuban (1993) described as 'cultural beliefs about what teaching is' that are held by society at large as well as teachers' own conceptions of teaching. Such beliefs include views of: how learning occurs (e.g. Cuban 1993); what constitute valid sources of expertise (e.g. Somekh 1989a) and 'proper knowledge' in schools (e.g. Cuban 1993); risk-taking (e.g. Somekh 1989b); roles (e.g. Sheingold *et al.* 1983) and who is responsible for learning in schools (e.g. Somekh 1989b); and the nature of teacher-student relationships (e.g. Blumenfeld *et al.* 1979; Kerr 1991; Cuban 1993). There was also widespread confirmation of the importance of classroom management issues, which Brown and McIntyre (1982) identified as being one of teachers' main areas of concern.

Sandholtz *et al.* (1990) found that Apple Classroom of Tomorrow (ACOT) teachers in the early stages of computer use were hindered by characteristics of their physical environment, such as the amount of space in their classrooms and problems with lighting and power supplies. Rhodes and Cox (1990) also specifically noted access to power points and the size of the classroom as being problems. More commonly reported problems with classroom management related to the ease with which computers could be integrated with existing classroom practice (e.g. Rhodes and Cox 1990). For example, where group working was already seen as valuable computer use was more likely to occur (Hall and Rhodes 1986). Hadley and Sheingold (1993) found that problems with integrating computers with 'the system' was one of seven barriers to computer use that accounted for 50% of the variability in their data.

Many sources found that using computers made teaching more difficult at least initially (e.g. Wiske, Zodhiates, Wilson, Gordon, Harvey, Krensky, Lord, Watt and Williams 1988; Kerr 1991). Sandholtz *et al.* (1990), who also found this to be the case in the ACOT schools, noted that changes in practice associated with increased computer use were accompanied by changes in classroom dynamics and introduced new forms of 'student misbehaviours and attitudes'. For example, they recorded increases in noise levels, greater movement of children around the classrooms, and changes in roles, with students often knowing more than the teachers and sometimes resisting the teacher's directions. These changes often challenged teachers' conceptions of their role:

> Since computers facilitated independent learning, some teachers felt that they were no longer teaching ... They wondered if they were accomplishing their main goal of 'teaching students the content'.
>
> (Sandholtz *et al.* 1990 p.5)

At the same time increasing computer use was often found to increase teachers' workload (Olson and Eaton 1986; Rhodes and Cox 1990). Although some researchers also identified that technology could relieve certain pressures (Kerr 1991), for example by increasing pupil motivation and/or relieving administrative burdens (e.g. Wiske *et al.* 1988). However, Somekh (1989a; 1989b) noted that the main focus of institutions was on computer use in the classroom (i.e. with children) rather than by teachers as tools for their own work.

Kerr (1991) argued that problematic assumptions about what technology is good for, combined with conceptions of teaching and the teacher's role played an important part in explaining the uneven impact of technology on classrooms. Furthermore, he claimed that there was a lack of vision about how these elements might come together and what this might look like to a practising teacher.

Vision building

There was wide support in the literature for the view that one of the key factors inhibiting computer use in schools was a lack of vision (e.g. Bell 1993a), which was often expressed as a lack of clarity about the innovation and/or its intended goals (e.g. Gross *et al.* 1971; Plomp *et al.* 1990; Rhodes and Cox 1990; Pelgrum and Plomp 1991).

Fullan (1992) identified vision building as having two components: a description of the target of the change and of the process through which that target was to be achieved. Dwyer *et al.* (1990) claimed that one of the reasons that technology had not impacted on education in the way that it had done in science and industry was because "the goals and means in the education arena were vague" (p.4). Fullan and Stiegelbauer (1991) referred to this as the issue of clarity, which they saw as being a major problem during the implementation of change: "Problems related to clarity have been found in virtually every study of significant change" (p.70).

A key aspect of the notion of vision is the need for such vision to be shared by all the people involved in the change process. Hall and Hord (1987) noted that different people could have very different perceptions of a particular change process and that bridging the gap between these different perceptions was an essential first step if the change was to be successfully implemented. Cuban (1988) noted that one of the reasons why education appeared to have changed so little, despite the vast amounts of investment in educational change, was due to differences in perception of the value of those changes. Fullan (1993) agreed that it was essential for any vision associated with an educational change to be shared by all those involved. He stated that "shared vision, which is essential for success, must evolve through the dynamic interaction of organisational members and leaders" (p.28). Visions need to be dynamic therefore, reflecting the dynamic nature of change; hence Fullan's use of the term vision building. This applies to both the goals that are being aimed for and the implementation processes.

What was unclear from the literature was what the best ways of using computers in education were (Bell 1993a; 1993b; Cuban 1993) and hence what visions of computer use ought to look like. This was also reflected in the need for further research to help identify effective ways of using computers, which was commonly recommended (e.g. Sheingold *et al.* 1983; Lepper and Gurtner 1989; Pelgrum and Plomp 1991).

Shiman and Lieberman (1974) claimed that by engaging teachers in thinking about problems and how to solve them, effective and relevant goals and strategies would emerge. Thus, they argued that it was important to start any change process from where the school (or people involved in that process) was at. This view was also reflected in the need for the goals underpinning computer use to relate to solving real problems that teachers faced (Bell 1993a); to make sense in terms of teachers' concerns (Brown and McIntyre 1982) and to be perceived by teachers to have benefits (Blumenfeld *et al.* 1979). Pelgrum and Plomp (1991) identified that one of the obstacles to the successful integration of computers in education was a lack of perception of the need for them. Whilst Robinson (1993) in her examination of the use of computer mediated communication in schools found the main factor determining success as being whether or not there was an educational need rather than a technological need for computer use.

Fullan and Stiegelbauer (1991) defined need as referring to the relative importance of one innovation compared to others which might be implemented, and identified that vision building “provides a screening mechanism for helping groups sort out and integrate competing priorities” (p.69). Pelgrum and Plomp (1991) identified that the perceived lack of relative importance of computer innovations was an obstacle to their successful implementation in schools.

Conclusion

The aim of the literature review was to identify key factors that had been found to effect the quantity and quality of computer use in schools. Despite the complexity of the variables involved in any change process (Huberman 1973), or more accurately, the complexity of the “dynamic process involving interacting variables over time,” (Fullan 1992 p.111), the review did highlight a number of variables that appeared to be particularly significant. This fitted with Fullan’s (1992) statement that “the evidence points to a small number of key variables. It is obvious that they work, yet how they work is not necessarily clear.” (p.110).

These key variables included: teachers’ attitudes, motivation, confidence and competence; leadership; institutional culture; INSET and support; time; access to and ownership of adequate quantities of high quality resources; and the ease of integration of computer use into existing classroom practices. Of these, those factors relating to improvements in hardware and software provision seemed the least intractable, and appeared to be universally recognised as being vital to computer use. Increasing the quantity and quality of resources also appeared to impact positively on many of the other key factors.

Increasing the quantity of hardware sufficiently to enable a whole group of children to all use computers simultaneously appeared to address several important issues. Firstly, it would increase schools' willingness to adopt computer use, as schools were more likely to adopt innovations that involved the addition of resources (Fullan 1982). Secondly, having sufficient computers for a whole group to use them at one time would reduce the extent to which teachers needed to alter the way in which they managed their classrooms, as having children working in groups was already a common form of organisation. Thirdly, it would increase the impact of what Sheingold *et al.* (1983) referred to as the 'teacher time investment', because the larger the number of children who could use computers simultaneously the greater the impact of any time the teacher spent on computer related activities. Thus, increasing the quantity of hardware would improve the cost:reward ratio for using computers and mean teachers were more willing to spend time on the preparation and implementation of computer tasks.

Providing portable computers rather than desktop machines also appeared to overcome a number of important obstacles to computer use, including addressing concerns about physical constraints related to computer use in classrooms, such as the amount of space required by the computers and the location of power points. The use of portable computers would also make it possible for the computers to come to the children rather than the children having to relocate in order to use the computers, thus further reducing the disruption to classroom organisation. In addition, using portable computers would make it easy for teachers to take a computer home with them, which would potentially increase their opportunities to spend time familiarising themselves with the software and provide them with greater privacy whilst so doing; increase their opportunities to spend time preparing activities for children; provide them with the opportunity to use the computer for their own professional purposes; and increase their sense of ownership of the technology.

Providing high quality equipment and one integrated software package with an accessible and consistent interface would reduce the time needed to learn how to operate the equipment and the number of technical problems that would be encountered. This in turn would reduce the need for technical support, the time spent solving technical problems and the level of technical competence required by the teachers. Providing one integrated application would have the added advantage of maximising the benefits of time spent on learning how to use the software because learning about how to operate one of the applications within the software suite would apply to the other applications as well. In addition, the content free nature of the software would mean that it could be used across the curriculum, thus increasing the opportunities for teachers and pupils to reinforce their knowledge of the software and to capitalise on the time spent learning how to operate it. The greater the amount of time that the computers were in use the greater the experience and competence the teachers would develop in integrating computers into their practice.

Thus, increasing the quantity and quality of resources by adding sufficient high quality portable computers with one integrated software suite seemed likely to lead to an increase in the quantity and quality of computer use. Fullan (1992) claimed that "In many cases, changes in behaviour precede rather than follow changes in belief" (p.128), which suggested that increasing the quantity and quality of resources would also impact on teachers' beliefs about computer use in education. Support for this view came from the ACOT research, within which teachers' beliefs gradually altered as a result of their experiences of working in an altered context where resourcing for computer use had been enhanced (Dwyer *et al.* 1990).

Shiman and Lieberman (1974) proposed a five stage process through which teachers beliefs might change, and visions (in the form of new educational goals) might be formed. This cyclical process, which started with actions and led to the development of new visions (in the form of educational goals), provided further support for the potential impact of adding more resources, by suggesting a mechanism through which it might operate (as illustrated in Table 1.2).

Table 1.2 A mechanism through which adding more resources might lead to significant changes in computer use (based on Shiman and Lieberman 1974 pp.442-443)

Stage	Description	Example
1	People talk about the possibility of bringing about some kind of change within the school.	Provide additional equipment in order to help school enhance its use of computers.
2	Activity ensues involving some but not all of the staff.	Some teachers use the additional equipment and in the process start to become more familiar with how to use it.
3	Out of such activity, teachers begin to ask questions.	Teachers start to see benefits from the computer use and to think about how they might capitalise on computer use to enhance other aspects of their work.
4	Old ways of doing things no longer seem adequate.	Teachers find computer use changes and improves some aspects of their practice.
5	The large philosophical questions get asked. Teachers begin to deal with goals for the first time.	Teachers start to see ways in which computers can transform learning and start to think about the implications of this.
The questions in Stage 5 lead back to Stage 1 again.		

This all seemed to suggest that increasing the quantity and quality of resources by adding sufficient high quality portable computers with one integrated software suite would lead to a self-sustaining cycle of increased quantity of use leading to increased quality of use with associated educational benefits and still further computer use (Figure 1.1).

The next stage in the research process was to identify the most appropriate methodology for investigating the robustness of this model.

Chapter 2
Research Methodology

Introduction

In the previous chapter a proposition emerged from the literature about one way of enhancing the impact of investments in ICT in schools. This chapter focuses on the most appropriate methodology for investigating the veracity of that proposition. The issue of research methodology is clearly crucial to any study, as it underpins the types of questions that can be addressed and the nature of the evidence that is generated (Clark, Lotto and Astuto 1984; Shulman 1986). The approach employed also has implications for the uses that can legitimately be made of the research outcomes. For example, within an empiricist approach it would be assumed that one could make generalizations based on research findings whilst this may not even be a goal for many interpretivist researchers (Schofield 1993). Thus, the purposes underpinning one's research need to inform the methodology employed (Underwood and Underwood 1997).

Robson (1993) described three different purposes underpinning research in the social sciences: exploratory research, which aims to seek new insights, ask questions and find out what is happening; descriptive research, which aims to provide an accurate profile of the situation or phenomenon being studied; and explanatory research, which aims to explain the phenomenon being studied, often in the form of causal relationships. The description of explanatory research seemed to fit most closely with the proposition developed in the previous chapter, which was based on a set of suggested causal relationships.

Robson (1993) went on to suggest that the purpose of the research helped to determine the most appropriate research strategy. He loosely linked case studies with exploratory work, surveys with descriptive studies, and experiments with explanatory research. This suggested that an experimental approach might be the most appropriate in order to test the veracity of the proposition that increasing the quantity and quality of computer equipment would lead to increases in the quantity and quality of computer use. However, the use of experimental approaches in educational research, which by definition rely upon the control of variables, have been widely criticised from both pragmatic and philosophical perspectives. Whilst even advocates of experimental approaches to research in education recognise the limitations of the use of artificial contexts, experimental approaches based within authentic educational settings have been criticised because of practical and ethical problems associated with attempts to control the variables in such contexts (e.g. Hammond 1994; Venezky 2001). Philosophically, experimental approaches have been criticised on the basis that they, like other 'scientific' approaches, ignored the differences between people and the objects of study of the natural sciences (Fenstercacher 1986). In essence this criticism claims that the assumptions underlying experimental approaches are invalid, at least when applied to the study of social phenomena. This is a paradigmatic argument, which is often expressed in the form of a debate about the extent to which quantitative and qualitative approaches can be combined (Bryman 1988). Understanding this argument, and coming to a view about it appeared to be an important step in the process of deciding upon the most appropriate research methodologies for this study.

The Quantitative *vs* Qualitative debate

Robson (1993) noted that quantitative research, which is also referred to as positivistic, natural-science based, hypothetico-deductive, and 'scientific', is typically seen as involving approaches to data collection such as experiments and surveys. He also identified that qualitative research, which is labelled interpretive and ethnographic, is typified as involving case studies, observation and interview.

Bryman (1988), in summarising the debate about the extent to which one can legitimately combine quantitative and qualitative research, identified two different ways of viewing them. The first position sees the distinction between qualitative and quantitative research as relating to different ways of collecting data and claims that one needs to choose the best method on the basis of the technical constraints of each. The alternative stance is that quantitative and qualitative research represent incompatible views on how the social world should be studied: "they are viewed as competing views about the ways in which social reality ought to be studied, and as such they are essentially divergent clusters of epistemological assumptions, that is, of what should pass as warrantable knowledge about the social world" (Bryman 1988 p.5).

Thus, at one extreme there are researchers who argue that one can mix and match between quantitative and qualitative research (e.g. Tesch 1990; Underwood and Underwood 1990). At the other extreme are those who argue that quantitative and qualitative research, because of their different underpinning assumptions about ontology and epistemology, represent distinct and incompatible paradigms (e.g. Scott and Usher 1999). In the middle are researchers, such as Hammersley (1992), who dispute the significance of the differences between the philosophical underpinnings of quantitative and qualitative research and thus argue that they are not mutually exclusive, and others, such as Willis, Thompson and Sadera (1999), who whilst appearing to acknowledge paradigmatic incompatibilities, still argue that we should attend to research from all paradigms.

Examination of this debate suggested that one could consider research at a number of different levels. For example, Strauss and Corbin (1998) distinguish between Methodology and Methods, whilst Scott and Usher (1999) differentiate between ontology, epistemology, strategy and methods (see Table 2.1 for a comparison of these two classifications). Both of these classifications distinguish between philosophical and technical levels at which one can consider research.

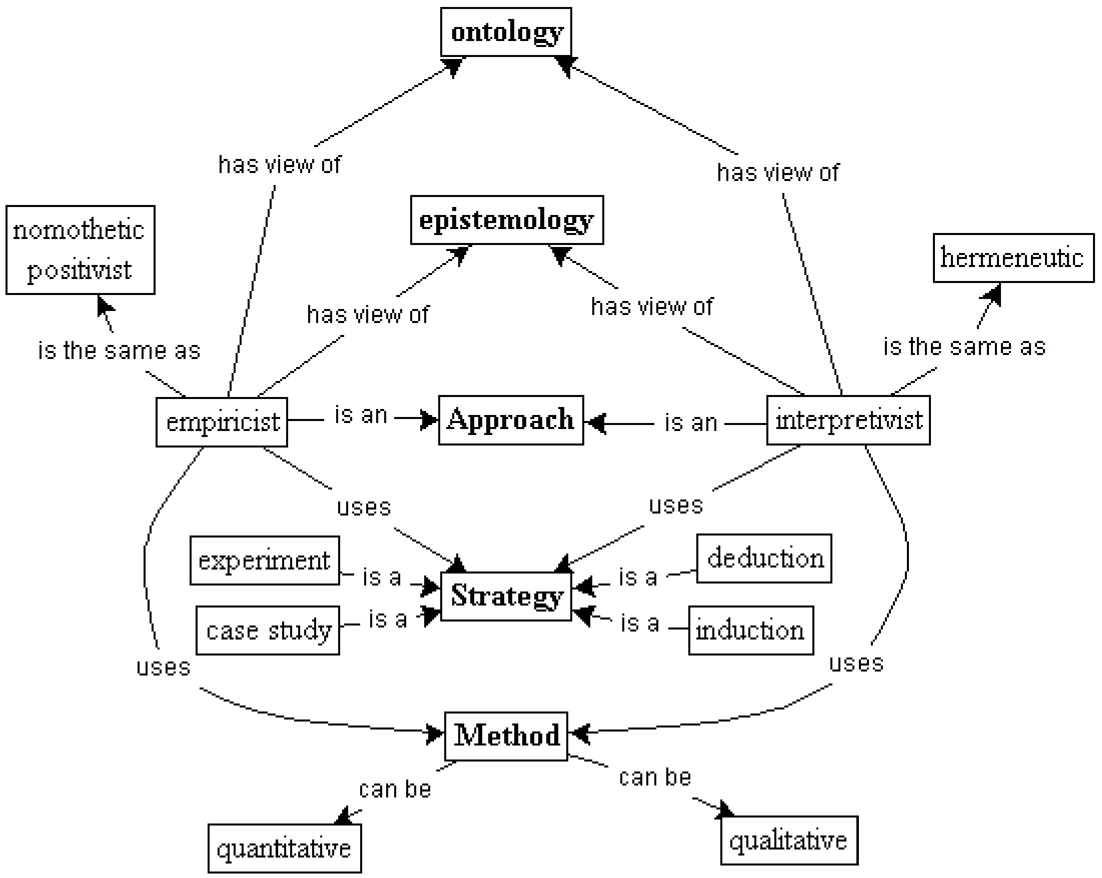
Table 2.1 Different 'levels' at which one can consider research

Strauss and Corbin (1998)	Scott and Usher (1999)
Methodology: a way of thinking about and studying social reality.	**Ontology**: the nature of the world – how it is.
	Epistemology: how we know the world – views of knowledge.
Methods: a set of procedures and techniques for gathering and analysing data	**Strategy**: research design using certain types of reasoning.
	Method: techniques for collecting and analysing data.

Figure 2.1, which is adapted from Scott and Usher's (1999) classification, shows another formulation of the different facets or levels at which researchers operate and the ways in which these different levels relate to each other. It illustrates the way in which different approaches to research are underpinned by different views of ontology and epistemology, and highlights that they make use of a variety of research strategies and methods. Figure 2.1 does not attempt to include all the different approaches, strategies or methods that are available, but provides illustrative examples.

This analysis of the levels at which research operates helped to clarify the quantitative-qualitative debate. Part of the explanation for the apparent disagreement about the extent to which quantitative and qualitative research could be combined appeared to be due to ambiguity about the level of research that was being discussed and at which paradigmatic labels should be applied. For example, Tesch (1990), unlike most authors, was clearly only considering the Method level when she defined quantitative research as being that which uses numerical data whilst qualitative research is any research which uses data which cannot be expressed in numbers. Willis *et al.* (1999), whilst applying the labels quantitative and qualitative at the Method level, argued that paradigms are not about data sources (quantitative re qualitative) but about what you do with those sources. Scott and Usher (1999), made the paradigmatic distinction between qualitative and quantitative research at the Approach level, which they tied in closely with the ontological and epistemological levels.

Figure 2.1 Relationship between different terms relating to research in social sciences



Even more problematically, many researchers do not clearly distinguish between these different levels. For example, Robson (1993) appears to merge the Approach, Strategic and Method levels, when he characterises quantitative research as being based on a 'scientific' approach in which theories are built through the formulation and testing of hypothesis through empirical means, as opposed to qualitative research, within which he states that the theories emerge from the enquiry and the boundaries between data collection and analysis are often blurred.

Further confusion comes from the different ways in which terminology is used within the literature. For example, Miller and Olson (1999) use the terms Methodology and Methods without making it clear what they mean by them:

> The selection of research methodologies should be driven by the nature of the questions under investigation rather than a predetermined idea that some research methods are superior to others
>
> (Abstract)

Ambiguity also arises where terminology is used differently by different authors. For example, Erickson (1986) takes the view that "a research technique [Method] does not constitute a research method [Approach]" (p.120 Text in brackets shows corresponding terminology used in this chapter). Here Erickson does explicitly distinguish between different levels at which one can consider research, but he is using terminology that does not match that used by other authors in the field (Table 2.2).

Table 2.2 Comparison of terminology used in the literature on research

Author	Terminology			
Strauss and Corbin (1998)	Methodology		Methods	
Scott and Usher (1999)	Ontology	Epistemology	Strategy	Method
Erickson (1986)	Method		Technique	

Despite the apparent differences between authors there appears to be considerable agreement once confusion about terminology and the level being discussed are removed. For example, Erickson's (1986) argument is that two researchers could both use observation - writing descriptions of what they see happening - but end up with very different descriptions because their orientation (Approach) is different. Willis *et al.* (1999) agree with this, in that they are essentially arguing that different techniques at the Method level (i.e. those that use numerical data and those that do not) are not incompatible but that there are incompatibilities as you move up to the Approach levels and above.

Thus, there appears to be fairly wide agreement for the stance taken by Scott and Usher (1999) in their discussion of this issue. They argue that different research approaches (as represented in Figure 2.1) represent different and incompatible paradigms. For example, empiricist and interpretivist research approaches are based on different ontological and epistemological positions, as summarized in Table 2.3. However, research strategies and methods are not paradigmatic in themselves. For example, an interpretivist can use both quantitative and qualitative data. Scott and Usher (1999) make the case that it is not the method that is used which determines the approach but the way in which that method is employed.

Table 2.3 Comparison of ontological and epistemological stances of empiricists and interpretivists (based on Scott and Usher 1999 p.2)

Empiricists	Interpretivists
There is one reality that can be known (determinancy).	There are multiple realities.
There are no contradictory explanations (rationality).	There may be multiple accounts.
The more objective and the less subjective the better (impersonality).	All data collection involves subjectivity – in the sense that what one perceives is dependent upon ones' beliefs, knowledge and interests.
Research is the making of knowledge claims in the form of generalizations from which predictions can be made, and events and phenomena controlled (prediction).	Research is about providing rich descriptions. All understandings are situated and thus not generalisable. At best one can establish consensus in certain contexts.

Taking this stance overcomes much of the apparent disagreement within the literature in relation to quantitative and qualitative research and allows one to take full advantage of the widest range of research methods, whilst remaining within the paradigmatic confines of one's particular research approach. This fits with Waxman and Bright's (1993) view that "The most effective programs of educational research reflect intelligent deployment of a diversity of research methods applied to their appropriate research questions" (p.2).

Taking this view does not mean however that any strategy can fit within any approach. The ontological and epistemological stance underpinning each approach has implications for the research strategies that are deemed appropriate. For example, an experimental research strategy, involving control groups or laboratory conditions, would clearly be linked with an empiricist approach and would not fit within an interpretivist one.

This exploration of the quantitative-qualitative debate helped to clarify the research methodologies that would be appropriate for this study. It highlighted the legitimacy of using a range of different research strategies and methods whilst still remaining within the paradigmatic constraints of an interpretivist approach, which most closely matched the epistemological and ontological views of the researcher. In order to further inform the decision about what strategy and methods to use in pursuing the proposition developed in Chapter 1 the methodologies used in previous research in the area of computer use in schools were explored. This raised a number of issues of relevance to this study.

Overview of research methodologies within the field

There has been a considerable amount of research into the use of computers in education (Moseley, Higgins, Bramald, Hardman, Miller, Mroz, Tse, Newton, Thompson, Williamson, Halligan, Bramald, Newton, Tymms, Henderson and Stout 1999) and the literature within the field is extensive (McFarlane *et al*. 2000). The research methodologies evident within the literature on computer use follow the general methodological trends evident within the educational research literature in general. This includes confusion about key differences between different research approaches, as illustrated for example by Willis *et al*.'s (1999) taxonomy of research approaches (Table 2.4), which appears to confuse key distinctions between them. For example, they seem to assume that the definitions of empiricism and interpretivism are based on methodological considerations compared with Critical Theory, which is defined in terms of ideology.

Table 2.4 A taxonomy of research into ICT in education (Willis *et al.* 1999)

<table>
<tr><td colspan="2" align="center">Critical Theory
Ideological stance, often focused on power relationships and equity issues.</td></tr>
<tr><td>Empiricism
Methodological stance, based on a positivist notion of epistemology and belief in scientific methods. Generally making use of sampling techniques, survey methods and/or controlled variables.</td><td>Interpretivism
Methodological stance, based on post-modernist notions of epistemology – "realities are local, transitory, and contextually based" (p34). Often based on 'constructivist' views of learning. Tends towards qualitative methodologies.</td></tr>
</table>

This confusion within the literature also involves ambiguity about the level of description of the research process, as discussed in the previous section. For example, Hadley and Sheingold (1993) identify two main types of research that are relevant to the question of the impact of ICT in schools: case studies and surveys. Their description of case studies and surveys, which is summarized in Table 2.5, suggests that they equate case studies with an interpretivist approach and surveys with an empiricist one, though they do not explicitly state that this is the case. These examples are typical of the lack of clarity about research methods within the field.

Table 2.5 Summary of Hadley and Sheingold's (1993) categorization of research on the impact of ICT in schools

	Surveys	**Case Studies**
Scale	Large	Small
'Sample' and hence generalisability	Representative and hence generalisable	Atypical and hence not generalisable
Timescale	Snapshot	Longer timeframe
Outcomes	Broad trends with little detail	Interesting insights
Implicit research approach	Empiricist	Interpretivist

Within the educational research literature as a whole there was a shift from predominantly empiricist approaches to a greater reliance on interpretivist ones. Clark *et al.* (1984), in their review of the school effectiveness literature, identified this shift as occurring around 1970, with the pre-1970 period being dominated by studies that adopted an empiricist approach and the post-1970 period being when the emphasis moved towards an interpretivist approach. Walker (1992) argued that "the old order based on an empirical-scientific-positivist doctrine has lost its grip on the field," (p.98) but that "no new doctrine has yet achieved dominance" (p.98). In the area of computer use in schools this general trend applies, although it is still the case that survey based studies dominate the literature (Chalkey and Nicholas 1997; Miller and Olson 1999; Moseley *et al.* 1999; Willis *et al.* 1999; Cuban 2001). There have also been a small number of studies that combine survey and case studies (e.g. Watson 1993). In the late 1990s a number of research papers started to appear which can best be categorised as fitting a Critical Theorist approach (e.g. Selwyn 2000).

It is clear from the computer use in schools literature that there are a number of issues relating to the ways in which research has been carried out and the uses to which the outcomes of the research can be put. For example, a number of researchers have identified trends within the field that need to be borne in mind when trying to make sense of this research. Moseley *et al.* (1999) noted that

> when researchers initiate ICT activities for pupils they tend to use computer assisted instruction or computer assisted learning software where learning content is presented to pupils. By contrast, when teachers carry out action research, the preferred choice is more open ended or generic software.
>
> (p.vii)

Hadley and Sheingold (1993) noted two distinct features of research that used case studies: the introduction of technology for a particular purpose, which was often constructivist in orientation; and working in contexts where high levels of resourcing (equipment and staff) were available (e.g. ACOT) and which looked over a long time frame. This analysis was echoed by Miller and Olson's (1999) classification of research in this area, which they argued fitted into three main categories: *Visions*, which often tended to ignore or criticise teachers, and investigators were often advocates rather than 'neutral researchers'; *Lighthouse projects*, which were atypical in terms of the level of resourcing and the enthusiasm and commitment of the people involved to the technology, and in which it was often unclear which variables lead to changes; and *Large scale studies*, which often relied upon survey methods, though some (e.g. Watson 1993) used both qualitative and quantitative techniques. This latter group they sub-divided into those that were investigating factors involved in innovation and those that were trying to bring about systemic change, often with a particular view of how technology should be used.

A number of issues emerged from these analyses that were relevant to the design of this study. These included practical concerns relating to experimental strategies, such as the control of variables, and questions about causality in educational contexts. Other issues included: the validity and reliability of data, particularly in the context of self-evaluation or self-reporting; the level of detail provided; and the stance of the researcher. These impacted on the researcher's initial view that the most effective way to investigate the proposition developed in the first chapter would be to convert it into a number of hypotheses and then to test these using an experimental strategy. Such a strategy is based on the notion of being able to control variables using one of two techniques. The first involves the use of artificial contexts, such as laboratory experiments, whilst the second involves the use of control groups in 'real world' contexts. Due to substantial problems with the external validity of using the results from artificial contexts to inform practice in schools the use of laboratory experiments has become much less prevalent when it comes to research into computer use in schools, and would have been inappropriate for this study.

The use of control groups in pure experimental designs involves the allocation of samples from the target population to different conditions. In 'real world' educational settings this is normally impossible for practical and ethical reasons, as it would have been in this study. To overcome this problem researchers often adopt what Campbell and Stanley (1966) call quasi-experimental strategies in which existing groupings are used (e.g. whole classes of children). Efforts are then made to account for and thus eliminate the effects of differences between the groups that might otherwise render the findings invalid. This appeared to potentially fit the needs of this study. However, the notion that one can control all of the variables within an educational context, is highly problematic (e.g. Hammond 1994; Pisapia, Knutson and Coukos 1999; McFarlane *et al.* 2000).

The related problem of the difficulties of establishing causal links pertaining to computer use in schools is commonly noted within the literature (e.g. Clark *et al.* 1984; Schrag 1999; Lewin *et al.* 2000; McFarlane *et al.* 2000). Lockee, Burton and Cross (1999) in their critique of 'media comparison studies' in the context of distance education, state the problem with experimental designs somewhat more forcefully when they say that "the futility of comparison studies to measure the impact of media on learning is consistently recognized in the field of instructional technology" (p.34). Similarly, but in the context of exploring the impact of ICT in schools, Venezky (2001) argues that

> Schools, however, are complex organizations that cannot be as easily pulled apart for analysis of the separate components. Nor can schools be controlled experimentally such that all variables except the ones we are interested in are held constant.
>
> (p.30)

This suggested that an experimental strategy would not be appropriate in this case. However, Underwood and Underwood (1997), whilst accepting the complexity of educational contexts and the problems associated with the control of variables, claim that experimental strategies are still appropriate in education. They draw parallels with medical research, in which there are as many issues relating to the control of variables but experimental design has still been shown to be useful. Their argument is that well designed experimental studies, can help to illuminate causal relationships. They argue that if computers lead to changes that in turn bring about educational benefits "the understanding of the specific causes of change is a secondary issue, even if the causes are at all separable" (Underwood and Underwood 1997 p.34). In other words they are claiming that it does not matter that one cannot control all of the variables so long as you can show that there is a learning gain associated with computer use. Thus, the use of a quasi-experimental approach, using established class groups and comparing the quantity and quality of computer use before and after the addition of high quality portable computer resources appeared to be an appropriate strategy.

Experimental and quasi-experimental strategies generally involve statistical analysis of the data. Underwood and Underwood (1997), for example, argue in favour of the use of certain statistical techniques, such as multi-variant analysis, within the context of well designed experimental studies, to reveal that an intervention has had an effect. The inappropriate use of statistical techniques has been criticised in the literature, for example, Mitchell (1997), in his scathing attack on quantitative research, identifies this as one of the key mistakes that is common in the field. One facet of this is applying statistical analyses on data drawn from a sample that is too small. The use of correlations to draw conclusions about causal relationships is another example, which is clearly illustrated by a number of related studies carried out by BECTa (2000; 2001b; 2001c; 2002a), looking at the relationships between ICT in schools and students' attainment. The key approach in each of these studies was to show a correlation between the level of ICT resourcing in schools (as judged by OFSTED inspections) and the attainment of pupils on national tests (i.e. SATS or GCSEs). In each case BECTa reported finding correlations such as those illustrated in Figures 2.2 and 2.3.

Figure 2.2 % children achieving L5 or above at KS3 (redrawn from BECTa 2001c p.11)

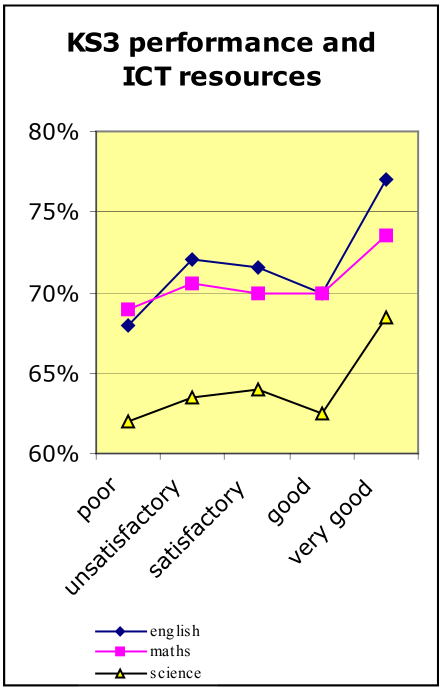
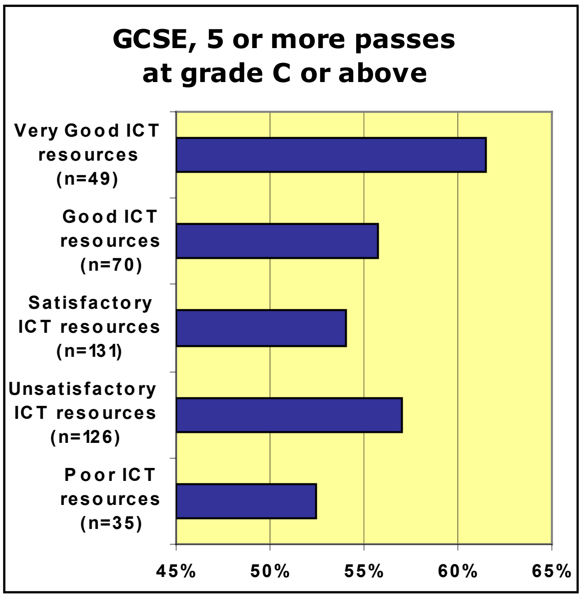


Figure 2.3 % children achieving 5 or more GCSEs at grade C or above against quality of ICT resources (redrawn from BECTa 2001c p.11)



Whilst the wording in these reports generally does not explicitly state that there is a relationship between levels of ICT resourcing and attainment there is a strong implication that this is the case both in these reports and in related BECTa and government materials. For example, the reports often use heading such as "The impact of ICT on standards over two years" (BECTa 2001b p.10) and do occasionally include statements such as "there was a very strong link between pupils' ICT attainment and standards, both at Key Stage 3 and GCSE." (BECTa 2001c p.8). The implication that because there was a correlation between the quality of ICT resourcing and pupils' attainment there was a causal connection between them is flawed because "Even if a correlation can be established between two variables, it is still not possible to assert, in an unproblematic way, that the one caused the other to happen." (Scott and Usher 1999 p.80). Indeed, following the publication of the first of these reports by BECTa the UK Publishers Association (Watson 2001) demonstrated even larger correlations between the levels of spending on books in primary schools and pupils' achievements on SATs, using the same statistical techniques that BECTa had used. They reported that "This is a stronger positive relationship than that between ICT provision and school attainment as calculated by BECTA" (p.1).

Given the practical restrictions on this study, relating to the amount of time needed to collect the data and the cost of providing additional computer equipment, the number of classes that could be used would be limited. This meant that statistical analysis of this data was unlikely to be appropriate. However, in order to establish the veracity of the proposition that adding additional high quality equipment would increase the quantity and quality of use, causal relationships did need to be explored.

Underwood and Underwood (1997) argue that having identified that there is an effect using experimental strategies one can then utilize qualitative strategies to enrich one's understanding of that effect:

> The first commonly-voiced objection is that empirical methods do not tell us why something works or happens, although a series of experiments that controls potent factors can aid in this understanding. What it certainly does is to indicate where there is an effect which is worthy of further investigation in order to gain a fuller understanding. What it can also do, working the other way round, is to find out if a one-off, casually observed effect is replicated in other situations.
>
> (p.35)

In essence, Underwood and Underwood (1997) are arguing that quantitative methods can tell us if something has changed, but that in order to understand how or why the change took place one needs to use qualitative methods. Scott and Usher (1999) agree that understanding social phenomena requires the use of qualitative techniques:

> quantitative researchers are not able to deal with the intentions, beliefs and propositional attitudes of social actors. If they try to, they are engaged in processes of reification, packaging and ultimately distortion. This suggests that data-collection processes which do not involve quantification will have to be employed to fully understand the nature of the social world.
>
> (p.92)

This suggested that the most appropriate way to explore the proposition would be to use a mixture of quantitative and qualitative data collection, using either case studies and/or surveys.

As has already been identified, surveys are commonly used by researchers interested in computer use in schools. Whilst all surveys, by their very design, rely upon respondents to provide information, a particularly common form of response is self-assessment (Harris 1999; Cuban 2001). For example, using surveys to explore the impact of increased levels of computer resourcing on the quantity and quality of computer use would require teachers to self-assess the quantity and quality of computer use before and after the addition of extra equipment. There are a number of potential problems with self-assessment, including overly subjective responses as well as misrepresentation.

Where rating scales are not clearly explained there is a danger that responses may be overly subjective (Harris 1999). For example, if asked to rate the impact of ICT on pupils' learning on a scale that included the options 'None', 'Little' and 'Substantial' it would not be surprising if there was variation in the way in which respondents interpreted those terms. Not only is the boundary between 'Little' and 'Substantial' unclear, but the options are also skewed with little scope for discrimination. In particular, it is unclear how one would rate the impact of ICT on pupils' learning on this scale if it fell somewhere between 'Little' and 'Substantial', as it easily might.

Cuban (2001) criticises surveys on the basis that they "are essentially self-reports and so are prone to inflation and selective memory." (p.120). In essence he is arguing that misrepresentation may take place either deliberately or unwittingly. For example, if a head teacher is asked to 'indicate on average how many minutes per week each child in your school spends using a computer' she is unlikely to know the answer to this question. She may have enough information to be able to calculate the answer, but it is much more probable that the best she can do is make a 'reasonable' estimate. In making that estimate the head teacher may overestimate the amount of computer use, either by unconsciously giving too much weight to the times she has noticed children using computers or deliberately, perhaps because she is concerned about the under use of such an expensive resource. Indeed, Chalkey and Nicholas (1997) found that "there is a tendency for respondents to over-estimate their use of computers." (p.98).

Inevitably there are power-relationship issues in any research, and these may exacerbate misrepresentation issues. For example, the UK government (DfES) carries out regular surveys of computer use in schools, which are based on self-reporting by head teachers (or their representatives). Given the UK government's position as the key funder of these schools it seems possible that head-teachers will be keen to respond in ways that will cast their school in a good light. Indeed, comparing the DfES data with that collected by an 'independent source' (BESA 2001) suggested that the government data on expenditure exaggerated the levels of investment (see Table 2.6).

Table 2.6 Comparison of the levels of expenditure on ICT in primary and secondary schools in 2001, based on data from different sources

	Primary schools		Secondary schools	
	UK (BESA 2001)	England (DfES 2001)	UK (BESA 2001)	England (DfES 2001)
Average total ICT expenditure per school	£7,620	£10,300	£34,640	£60,300
Estimated total ICT expenditure	£175.6million	£186million	£156.5million	£210million

In comparing these figures it is important to remember that the DfES data related just to England, whilst the BESA data covered the whole of the UK. One would thus have expected the BESA figures for total expenditure to be higher than the DfES ones, which was not the case. This suggested that caution needed to be exercised about the use of surveys that involved self-reporting, particularly in contexts where the respondents might be keen to be seen in a good light.

Another potential disadvantage of surveys relates to the amount of detail that they can provide. They tend to provide a broad but shallow picture (Hadley and Sheingold 1993), which may lack the level of detail needed in order to differentiate between key factors that play an important part in computer use in schools. Lewin *et al.* (2000) identify this as being a particular problem in the context of identifying the impact of ICT on learning because of the important role that the way in which software is used has on the learning outcomes and "because the micro features that differentiate between classrooms or activities where effects are occurring and those where they are not are too specific to be picked up by the research design." (p.23). This suggested that surveys would not be appropriate for exploring the causal relationships within the proposition formulated in Chapter 1.

The need for greater detail in the data on computer use in schools has lead to there being substantial support in the literature for the use of observational techniques to help enrich our understanding of the interactions between teachers, pupils and technology (e.g. Chalkey and Nicholas 1997; Kent and McNergney 1999; Miller and Olson 1999; Moseley *et al.* 1999; Willis *et al.* 1999; Cuban 2001). This fits with the use of case studies, which Robson (1993) defined as being "a strategy for doing research which involves an empirical investigation of a particular contemporary phenomenon within its real life context using multiple sources of evidence" (p.146). A case study strategy appeared to address the issues of concern to this study. It would enable the proposition to be explored in depth, using a range of quantitative and qualitative techniques and would provide a 'rich picture', which could not only help establish whether the proposition was correct, but also provide evidence about how the different factors interacted. This would also be manageable within the practical constraints operating on the research.

The initial case studies

A case study strategy was therefore adopted to explore the initial proposition that increasing the quantity and quality of resources by adding sufficient high quality portable computers with one integrated software suite would lead to a self-sustaining cycle of increased quantity of use leading to increased quality of use with associated educational benefits and still further computer use. In order to focus the data collection and analysis the proposition was broken down into a number of sub-statements, or hypotheses, each of which could be explored in isolation. This necessitated collecting both quantitative and qualitative data relating to as wide a range of aspects of computer use as possible both before and after the alteration of the independent variables (the quantity and quality of equipment).

Having decided upon the use of case studies a number of practical and methodological considerations had to be borne in mind. For example, the research needed to be made sufficiently attractive to enable the researcher to gain access to suitable classrooms in which to carry out the research. Ball (1993) distinguishes between gaining entry to a school and gaining access. The former involves being granted permission to conduct the research, normally by the head teacher, whilst the latter requires the co-operation of the teachers and students who are to take part in the research. Many of the factors that contributed to the formulation of the proposition in Chapter 1 were also relevant here. For example, providing additional resources was likely to make the research more attractive to head-teachers, thus making it easier to gain entry to suitable schools. Similarly, minimising the disruption to the teacher's classroom organisation by providing sufficient portable computers to enable a whole group of children to use a computer simultaneously, was likely to make it easier to gain entry to individual classrooms. The way in which the research was to be carried out was carefully planned in order to increase the likelihood that teachers would co-operate. This included consideration of ethical issues and methods of data collection.

The research was designed within an ethical framework in which the potential power differential between the researcher and the teachers was recognised. This framework included principles such as: the need to ensure that participants in the research understood its purpose, including that it formed part of a doctoral thesis; the importance of protecting confidentiality, for example by changing names in any reports of the research; and the need to respect the rights and views of the people concerned and understand the potential impact of the research upon them. Importantly, the framework called for mechanisms to be put in place to provide teachers with full access to the data and opportunities to amend, annotate or veto the use of any of that data. This was in order to partially address ethical issues about who controlled the data and how it could be used (Nias 1993) and thus help to minimise the risk of inadvertently causing harm to the teachers involved with the research (Erickson 1986).

In planning the data collection, care was taken to minimise the amount of extra work required of the teachers, with the main burden for data collection falling on the researcher. Thus, for example, with the teachers' permission, the researcher made copies of the teachers' existing paperwork such as plans and records. The only data collection that the teacher was asked to manage was the completion of Manual Logs of computer use (See Appendix A for a sample Manual Log). However, the Manual Logs were designed to minimise the time taken to complete them, and to be sufficiently simple so that the children could fill them in. Where possible the Manual Logs were supplemented by the use of automatic logging software on the computers, which kept track of what software was being used and for how long. Extensive use was also made of observation data, which was collected by the researcher.

In planning how best to collect observation data within the classrooms the researcher, who was a qualified primary school teacher, decided to act as a participant observer rather than a non-participant, on the basis that this would be less threatening to the teachers, would provide them with additional help in their classrooms, and would help to create a more equal relationship between the teachers and researcher. The stance of the researcher was deemed to be very important both in terms of developing constructive and supportive relationships with teachers but also in order to avoid skewing the data by adopting a position of advocacy in relation to computer use. This was a problem identified by Miller and Olson's (1999) in relation to research that they classified as *Visions,* and to a lesser extent *Lighthouse projects*, which they noted were often sponsored by large companies (e.g. Apple and ACOT), who at least potentially had a vested interest in the outcomes. Moseley *et al.* (1999) raise similar doubts about the quality of the evidence upon which claims about learning gains were made in research that was funded by hardware companies.

Clearly, adopting a position of advocacy during the data collection would bias the data, reducing its validity. Schrag (1999) noted that there was an over reliance on advocacy in this field and suggested a corresponding propensity to use opinion rather than evidence. This highlighted the importance of the neutrality of the researcher not only during the data collection but also during its analysis and reporting, in order to prevent the conclusions being based on opinion rather than evidence. Whilst BECTa (2001b) seemed to support this view when they state "thus far the research into whether ICT has effects, … is an area of more assertion than evidence." (p.3), this did not seem to prevent them from appearing to adopt a partial stance when it came to reporting their own findings on the impact of ICT on learning outcomes (e.g. BECTa 2001b; BECTa 2001c).

One way to help to minimize the risk of researcher bias is through triangulation of the data. This emphasized the importance of the use of multiple data sources, using a range of data collection techniques. Having both qualitative and quantitative data from a range of sources would make it possible to carry out methodological triangulation of the data (Blease and Cohen 1990), in order to enhance the validity of the conclusions drawn (Bryman 1988). Similarly, the plan to provide teachers with access to and control over the data and the use that was made of it represented another form of verification (respondent validation) aimed at ensuring the validity of the data (Blease and Cohen 1990).

The data collection was planned to take place in three phases. The first phase was to focus on establishing the whole school context within which the case study classes were set, in view of Miller and Olson's (1999) concerns about the use of case studies leading to a micro-focus and losing sight of the overall picture. The data collection during this stage was planned to include: analysing a range of documents, such as the school prospectus, school development plan and policy documents; administering a questionnaire, based on the ITTE student IT competence questionnaire (See Appendix B) to all the teachers in the case study school; carrying out semi-structured interviews with every teacher in the case study school in order to clarify their responses to the questionnaire and to probe more deeply into their pedagogy and practice both generally and specifically in relation to computer use; and the use of field notes to record observations made by the researcher whilst in the school. As the researcher operated as a participant observer during these visits, working with groups of children who were *not* using IT. The intention was to write up the field notes straight after each visit.

The second stage of data collection was planned to focus on the case study classrooms prior to the addition of the extra computer resources. Whilst the main aim during this stage was on the quantity and quality of computer use, it was also planned to collect data to provide a rich picture that would provide insights into other issues that impacted on effective computer use. During this phase the techniques used in the first phase were to be supplemented by the use of additional data collection techniques. The Manual Logs were developed in order to collect data about the date, name(s) of people using the computer, start time, end time, name of program, and brief description of what they were doing (e.g. Copy typing). Individual Manual Logs were provided for each computer (see Appendix A for a sample Manual Log). The document analysis during this stage was focused on the teachers' schemes of work, plans and records. Informal interviews with the teachers were also planned.

The third phase of data collection planned to focus on the case study classrooms after the addition of the additional computer resources. As with the second phase of data collection, the focus here was on the quantity and quality of computer use, and providing a sufficiently rich picture of that use in order to reveal insights into issues impacting on the level of computer use. The same data collection techniques were used as in stage two, with the addition of the use of software on the additional computers, which automatically recorded the name of the currently active window and the length of time it remained active. Samples of children's work from the additional computers were also analysed.

In practice there were minor alterations to the design of the case studies when they were implemented, which are detailed in Chapter 3. The outcome of the initial analysis of the case studies suggested that the proposition developed in Chapter 1 was flawed. However, these case studies also highlighted a potentially more productive direction for the research and lead to further fieldwork.

Research approaches and methods subsequent to the first case studies

Following on from the first three case studies, which explored the proposition that was developed in Chapter 1, the focus of the research altered. Specifically, it moved away from trying to develop causal models underpinning the level of computer use in schools and moved on to try to examine ways of describing computer use in education. The rationale for this, which is explained in more detail in Chapter 4, was that being able to describe changes in computer use was a pre-cursor to being able to explain those changes. Thus, whilst the overall purpose of the research remained to find ways to enhance the impact of investments in ICT in education, the way in which this was to be achieved was revised. This alteration to the research question was accompanied by some changes in the research strategies that were used. Table 2.7 provides an overview of the key research questions addressed and methods used, and how these relate to the structure of the thesis, which also corresponds to their chronological sequencing.

The change in research focus following the first three case studies was facilitated by the availability of rich data from multiple sources for the first three case studies. This proved invaluable as it made it possible to apply retrospectively existing frameworks for describing computer use to the first three case studies, in order to explore those frameworks' strengths and weaknesses. This lead to the development of a set of criteria for evaluating such frameworks. The rich data from these first three case studies also revealed unexpected features of the practice surrounding computer use, which formed the basis for the development of the first version of a new framework for describing computer use in education, called the Computer Practice Framework (CPF).

Table 2.7 Summary of progression of research within the thesis

Chapter	Activity	Research Questions	Strategy/Method
3	Case Studies 1-3	Does increasing the quantity and quality of computer resources by adding 5 portable computers lead to a self-sustaining cycle of increasing quantity and quality of computer use?	Case Study
4		How well do existing frameworks describe the case studies? What does this tell us about the criteria for evaluating such frameworks?	Analysis of existing frameworks through their application
5		What are the key issues emerging from Case Studies 1-3? What would a framework (the CPF) that describes them look like? How does this framework measure up to the criteria?	Inductive analysis of case study data
6	Case Studies 4-5	How does the CPF measure up to the evaluation criteria when applied in primary classrooms?	Case Study
	Use in HE	How does the CPF measure up to the evaluation criteria when applied in a very different context?	Questionnaires
7	ITTE Focus Group	How could the CPF be refined?	Focus group & Questionnaire
	Case Study 6	How well does the CPF measure up against the criteria of reliability and validity when used in primary classrooms?	Case study
	Inter-operator reliability testing	How well does the CPF measure up against the criteria of inter-operator reliability?	'Experiment'/Survey (Controlling variables) – questionnaire

As the CPF started to be developed the nature of the research process also started to change. It started to incorporate more elements that are characteristic of an action research strategy. Elliott (1991) defines action research as "'the study of a social situation with a view to improving the quality of action within it" (p.69) and goes on to describe how action research

> aims to feed practical judgment in concrete situations, and the validity of the 'theories' or hypotheses it generates depends not so much on 'scientific' tests of truth, as on their usefulness in helping people to act more intelligently and skillfully … In action-research 'theories' are not validated independently and then applied to practice. They are validated through practice.
>
> (p.69)

The pattern of activity started to follow a spiral of planning, acting, observing and reflecting similar to the Elliott's revised version of Lewin's model of action research (Elliott 1991), as illustrated in Table 2.8. Reflection and analytical thinking about the CPF were an important part of this process and led to changes in the focus of data collection as well as to the definition of the CPF and ultimately the conception of its potential role in enhancing the impact of investments in educational ICT.

Table 2.8 Mapping of the development of the CPF against Elliott's revised version of Lewin's model of action research

Cycle 1	Identify initial idea	Need for framework to describe computer use
	Reconnaissance	Identify existing frameworks
	General Plan – Action steps	1) Apply existing frameworks to Case Studies 1-3. 2) Develop criteria for evaluating such frameworks. 3) Devise Computer Practice Framework – based on key distinguishing features of Case Studies 1-3. 4) Evaluate CPF against criteria devised in step (2).
	Implement action steps	
	Monitor implementation and effects Reconnaissance	Shortcomings in CPF identified and explained.
	Revise General Idea	Changes made to CPF.
Cycle 2	New action steps	Need for further evaluation in new contexts. 1) Further case studies in primary schools. 2) Using CPF in higher education.
	Implement action steps	
	Monitor implementation and effects Reconnaissance	Shortcomings in CPF identified and explained.
	Revise General Idea	Changes made to CPF.
Cycle 3	New action steps	Need to evaluate CPF further. 1) ITTE focus group. 2) Case Study 6. 3) Inter-operator reliability testing.
	Implement action steps	
	Monitor implementation and effects Reconnaissance	Shortcomings in CPF identified and explained.
	Revise General Idea	Changes made both to definition of CPF and the way in which it should be used.

Inevitably, the clear delineation of stages within the modified action research cycle represented in Table 2.8 is an oversimplification. Strauss and Corbin (1998), in discussing 'the flow of work' in ethnographic research, note that it would be unusual for research to neatly follow through a planned sequence of activity because "research really is a rather 'messy affair'." (p.32). This was reflected in this research, where in practice there were a number of iterations within the cycles shown in Table 2.8. For example, within Cycle 2 the CPF was modified after the first action step and before the implementation of the second action step, as illustrated in Table 2.9.

Table 2.9 Expansion of Cycle 2 to show the iterations within it

<table>
<tr><td rowspan="7">Cycle 2</td><td>New action steps</td><td>Need for further evaluation in new contexts.
1) Further case studies in primary schools.
2) Using CPF in higher education.</td></tr>
<tr><td colspan="2">Implement action step 1</td></tr>
<tr><td>Monitor implementation and effects
Reconnaissance</td><td>Shortcomings in CPF identified and explained.</td></tr>
<tr><td>Revise General Idea</td><td>Changes made to CPF.</td></tr>
<tr><td colspan="2">Implement action step 2</td></tr>
<tr><td>Monitor implementation and effects
Reconnaissance</td><td>Shortcomings in CPF identified and explained.</td></tr>
<tr><td>Revise General Idea</td><td>Further changes made to CPF.</td></tr>
</table>

As Tables 2.8 and 2.9 show, in moving on to evaluate the CPF against the criteria developed in Cycle 1 it was important to apply it to new contexts. The use of case studies again seemed appropriate as it was important that further unexpected features of computer use could be revealed in order to fully test the CPF. Case studies, as had already been shown by the first three case studies within this research, are an appropriate method to meet this aim (Robson 1993). In addition a method was needed that would allow the complexity and subtleties surrounding computer use in educational contexts to be described. Cohen and Manion (1989) highlight this as being a particular strength of case studies: "Case studies recognize the complexity and 'embeddedness' of social truths" and case study data is "strong in reality" and allows attention to be paid "to the subtlety and complexity of the case in its own right" (p.150). Thus the strategy of using case studies continued.

At the same time as Case Studies 4 and 5 were being carried out the evaluation of the CPF in the context of Higher Education was being planned. The key question in this instance was the extent to which the CPF could be applied in entirely different contexts. This required data collection from as broad a range of people as possible, spanning different subjects and higher education institutions. Whilst using a case study approach would have provided a richer picture of the computer use in these other contexts it would have severely limited the number of contexts that could have been studied. The use of a questionnaire was deemed to be more appropriate to meet this different set of requirements.

Within the third cycle the evaluation of the CPF was focused on issues relating to reliability and validity as these had been highlighted in Cycle 2 as being particularly important and potentially problematic. The initial conception of validity within this context was the extent to which the CPF provided an accurate representation of the computer use that it was describing. Reliability was taken as being the extent to which consistent descriptions of practice would be produced when the CPF was applied. The focus was on inter-operator reliability. Clearly the notions of reliability and validity are intimately linked. Indeed, Robson (1993) stated that "unless a measure is reliable, it cannot be valid" (p.67). Establishing whether or not the CPF was reliable was therefore taken as the first step in determining its validity and reliability.

The focus group helped to establish the extent to which the definitions of the different dimensions of the CPF were understood by academics working in the field and to identify any difficulties that there might be in applying them. Case Study 6 was designed to serve two functions: firstly to enable comparisons to be made between the two different respondents' descriptions based on the CPF; and secondly, to provide rich descriptions of computer use that could be used in the subsequent inter-operator reliability testing. The intention was to enable comparisons to be made between the descriptions based on the CPF of the 'same' practice by over 20 respondents. There were many shortcomings with this approach, some of which are discussed in Chapter 7.

Inevitably, there were also shortcomings with the design of the research, particularly in the earlier stages. For example, in the second case study it became apparent to the researcher that the head teacher had put the teacher under pressure to take part in the research. This represented an ethical dilemma for the researcher who had asked for teachers to volunteer to take part in the research and had tried to ensure that all those who took part were doing so willingly. In the subsequent case studies the researcher minimized the problems associated with the differential power between the head teacher and other staff by insisting on liaising directly with individual staff from much earlier on in the process of setting up the studies.

Despite these inevitable limitations the research reported in the remainder of this thesis did meet the "five formal requirements for any adequate and coherent educational science:" which Kemmis (1993 p.179) identified, based on his earlier work. These are:

> 1. it must reject positivist notions of rationality, objectivity, and truth;
> 2. it must employ the interpretive categories of teachers (or the other participants directly concerned with the practices under inquiry);
> 3. it must provide ways of distinguishing ideas and interpretations which are systematically distorted by ideology from those which are not, and provide a view of how distorted self-understandings can be overcome;
> 4. it must be concerned to identify and expose those aspects of the existing social order which frustrate rational change, and must be able to offer theoretical accounts which enable teachers (and other participants) to become aware of how they may be overcome; and
> 5. it must be based on an explicit recognition that it is practical, in the sense that the question of its truth will be determined by the way it relates to practice.
>
> (Kemmis 1993 pp.179-180)

The research also succeeded in meeting its overarching purpose, which was to find ways of enhancing the impact of investments in ICT in education. This is demonstrated in the remaining chapters of the thesis, which provide further detail of the research methods used, elucidate the data analysis, and discuss the outcomes and their contribution to this field.

Chapter 3
Testing key variables

Introduction

In Chapter 1 the proposition that increasing the quantity and quality of computer resources would lead to a self-sustaining cycle of increased quantity of use leading to increased quality of use with associated increased educational benefits and hence still greater use was presented. In Chapter 2 a case study strategy was identified as being the most appropriate way to explore the veracity of this proposition. More specifically the proposition was to be split into a number of hypotheses, which could be examined by collecting both quantitative and qualitative data both before and after the addition of equipment. The resultant hypotheses were:

a) Adding sufficient high quality portable computers, with one integrated software suite, to a class will increase the quantity of computer use;
b) If the quantity of computer use increases then the quality of computer use will increase, with associated increases in educational benefits;
c) If the benefits of using computers increases then the quantity of computer use will increase.

Design of the case studies

Most of the key decisions relating to the design of the case studies, including the data collection methods to be used, were discussed in the previous chapter. However, a number of important considerations remained unresolved. For example, decisions needed to be made about the number and type of portable computers and the most appropriate integrated software suite.

The quality of the equipment was clearly crucial both in terms of its reliability and ease of use, as noted in Chapter 1. It was therefore decided to use Apple PowerBooks, which, at the time, were viewed as being robust, reliable and easier to use than other available systems. It was also decided to provide Claris Works, which integrated word processing, database, spreadsheet, painting and drawing applications. Each of these applications had a consistent user interface; once you had learnt to operate one of the applications you had learnt much of what you need to know in order to operate the others. In addition Claris Works' interface had been designed to be consistent with the Apple operating system's user interface, so that if you knew how to use an Apple you also knew many of the conventions used in Claris Works.

The quantity of equipment required to have an impact was not clear from the literature, although Kerr (1991) had found that adding five machines per classroom did impact on practice. However, groups in most primary classrooms tended to consist of between 6 and 8 children in the researcher's experience, suggesting that providing 6 to 8 computers would be ideal. However, due to funding limitations it only proved possible to lease five Apple PowerBooks and one inkjet printer for a period of one year. This ultimately determined the amount of equipment that could be added. The first hypothesis was modified to reflect this decision, and became:

a) Adding five Apple PowerBooks with Claris Works to a class will increase the quantity of computer use.

Time restrictions combined with the funding limitations meant that a decision needed to be made about whether to limit the research to one case study over a period of one year or to carry out a number of shorter studies. One case study was not deemed to be sufficient. It was therefore decided to carry out a number of case studies based in separate classrooms within one school. Basing all the case studies in one school rather than using separate schools had the advantage of reducing the variability in the case study contexts and allowing the researcher to develop a better knowledge of the context for the three case studies.

The case study school was selected using three criteria. Firstly, it should be a full range primary school (i.e. with children aged from 5 to 11 years old) in order to enable the case studies to span a number of age groups. Secondly, the school needed to be accessible to the researcher both in terms of proximity and willingness to participate in the research. Finally, the school should, as far as possible, be a 'typical' primary school, in terms of its computer resources and use.

'County School' was selected as best fitting the three selection criteria. It was agreed that three classes would take part in the research. For each case study class the researcher needed to collect data about computer use prior to the additional equipment being made available and whilst it was available. A schedule for the three case studies was agreed with the school, which spread the researcher's workload as evenly as possible over the available time (Table 3.1). Within this schedule the researcher's visits to the school aimed to cover a range of different days and times and amounting to approximately half a day each week.

Table 3.1 Planned Schedule for the three case studies

Period of time	Researcher's focus	Location of extra equipment
1st half Autumn Term	Establish the whole school context	
2nd half Autumn Term	Collect data in 1st case study class	
1st half Spring Term	Collect data in 1st case study class Collect data in 2nd case study class	1st case study class.
2nd half Spring Term	Collect data in 2nd case study class Collect data in 3rd case study class	2nd case study class.
1st half Summer Term	Collect data in 3rd case study class	3rd case study class.

Due to the timing of Key Stage 1 testing the third case study class was not able to have the computers in the first half of the summer term as planned. Thus the planned schedule for the Case Studies was altered as indicated in Table 3.2.

Table 3.2 The actual schedule of machine availability for each case study

Term		Period	No of school days	No of Computers		
				Case Study 1	Case Study 2	Case Study 3
Autumn	2nd half	1	37.5	1.3	1.3	1
Spring	1st half	2	12	1.3 + 1 laptop	1.3	1
		3	20	1.3 + 5 laptops	1.3	1
	2nd half	4	28	1.3	1.3 + 5 laptops	1
Summer	1st half	5	28	1.3 + 5 laptops	-	1
	2nd half	6	34	1.3	-	1 + 5 laptops

Data analysis

A description of the case study school context is provided, followed by the analysis of the three case studies. In order to establish the extent to which the data from the three case studies supported or refuted the hypotheses each of the studies was analysed individually to establish the quantity and the quality of computer use during each period of the study. This information was then used to determine the extent to which the data from each case study fitted the hypotheses, by answering the following three questions, which corresponded to the three hypotheses:

a) Did the quantity of computer use increase when 5 PowerBooks were added?

b) Were increases in the quantity of computer use associated with increases in the quality of computer use?

c) Were any increases in the quality of computer use associated with further increases in the quantity of computer use?

If the answer to all three of these questions was 'Yes', that provided evidence to support the overall proposition that increasing the quantity and quality of computer resources would lead to a self-sustaining cycle of increased quantity and quality of computer use. However, if the answer to any one of the questions was 'No', that provided evidence that refuted that particular hypothesis and undermined the veracity of the overall proposition.

In order to ensure consistency in the interpretation of the data across the three case studies a framework was established for the analysis of the data. This included specifying the units of quantity to be used (average minutes computer use per day) and the criteria for defining the quality of computer use (Table 3.3), which resulted in an overall rating of the quality of computer use in each period on a scale from 1 (Excellent) to 5 (Poor).

Table 3.3 Criteria for judging the quality of computer use

High quality computer use will generally: • have been planned in advance; • involve the teacher (eg providing direction/focus/support/challenge; monitoring/recording); • be integral to other classroom activities (have a 'real' purpose); • enhance learning in areas other than IT (ie not be technology focused); • involve using IT whenever it can enhance learning (ie not be limited to specific 'IT' slots); • make full use of the potential of the technology.

The analysis of the data for each individual case study is reported in the following sections:

Description of the case study class
Analysis of the quantity of computer use during each of the Periods
Analysis of the quality of computer use during each of the Periods
Analysis of the extent to which the data from the case study fits the hypotheses

The chapter concludes with a discussion of the overall proposition in the light of the analysis of the three case studies.

The case study school context

'County school' was a single form entry, full range, county primary school. Thus there were seven classes, each with approximately 30 children. The school also housed an on-site pre-school playgroup. The school itself was a single story, modern building with a tarmac playground and adjoining sports field. In addition to the head teacher and seven class teachers there were the equivalent of 1.5 nursery nurses and a part time special needs teacher.

First impressions suggested that IT had not been a high priority for the school in the past. This view was supported by the level of investment in hardware and software, which amounted to just over £1000 in the year preceding this research (including £800 donated by the PTA) and less than £500 in the year that the research took place.

However IT had been identified as an agreed priority as part of a LEA curriculum review within the school 18 months before this research began. When the research started 'County School' had just completed the final draft of its IT policy, which was about to go to the governors for ratification. This had been drawn up over the preceding year by one of the teachers. Further evidence of the school having started to think more about their use of IT was the fact that they had organised a typing pool so that children's work could be sent home to be typed up by volunteer parents in order to avoid the children having to spend time copy typing.

At the Governors' AGM in November '93 the Head reported that there was a focus on staff development in IT and that she had been on two IT training days recently. The INSET records supported this to the extent that they showed that the head had attended one IT training day in the previous academic year and another in the current academic year, and that there had been a whole school staff development day on IT in the previous academic year. However, this was the total IT INSET shown in the records for these two years.

The level of IT competence of the staff as a whole within 'County School' was generally low. The head reported that there was no one on the staff with the competence to lead in the area of IT (Governors' AGM, November) and that she had thus taken on that role herself. The staff, she said, lacked confidence and problems arose when things did not go well and they did not know how to extricate themselves. When asked about the BBCs and whether they were out of date she responded that whilst it was true that the BBCs were old she thought that it was also true to say that the level of staff development was not such that they were beyond the BBCs - i.e. that they would not be able to cope with anything more sophisticated. This illustrates a low level of knowledge and/or understanding of IT by the head herself.

This view that the overall level of IT competence of the staff was generally low was supported to some extent by the self-ratings of IT competence by all eight of the teachers from the questionnaires, which they completed in the Autumn Term 1993. Over a range of 20 items, which included items that asked the teachers to rate their own competence on statements such as: "To appreciate the effects of computers on society and ethics" and "To use a computer in a modelling or simulation activity", the mean level of competence for the staff as a whole was 2.1 (SD 0.59) on a scale which ranged from 1 (unable) to 5 (expert). For those items that dealt with actually using a computer, but omitting word processing, the score fell to an average of 1.78 (SD 0.61) for the staff as a whole. Four out of the eight teachers each scored an average of 1 for these items; i.e. they believed themselves unable to operate a computer to do more than simple word processing. (See Appendix B for details of the questionnaires and summaries of the teacher's responses).

The quantity of use of IT with children in 'County School' was also generally low. Although each class within the school had access to one BBC with two additional A3000s shared between them (Field notes, November & Draft IT Policy) no teacher claimed in the Autumn term questionnaire to use computers with their children on a daily basis; the average claimed level of usage was monthly. However there was evidence from the field notes and interviews that two or three of the teachers did make more use of computers than this might suggest, though perhaps not on a regular or prolonged basis. The deputy head for example reported making extensive use of computers as part of a project using email with a local secondary school in the previous year.

One explanation for this low level of computer use emerged from informal discussions with some of the teachers. For example, several of the teachers expressed frustration over technical problems with the computers (Field Notes, 17th September & 3rd November) and reported that this had led to a reduction in their use.

Thus at the start of the research the overall level of IT competence and usage within County School could be summarised as being low, but with the profile and importance of IT being on the increase. Indeed, taking part in this research formed part of the increased emphasis on computers within the school and was seen by the head as a staff development exercise (Telephone conversation with Head, 10th July).

Comparison of County School's computer resources and those provided by this project

At the beginning of the project 'County School' had eight computers shared between 7 classes. These consisted of 1 BBC B (with monochrome monitor), 5 BBC Masters and 2 A3000s. Each machine had an associated dot matrix printer and there was one additional colour inkjet. There were also three concept keyboards and one modem. In effect there were two different types of computers with totally different user interfaces.

It was clear that much of the equipment was not in use. Some of the machines were not set up, the BBC B's monitor was not working and several of the systems had to share power points. For example, the two machines outside the Year 2 and Year 3 classes shared one distribution board, which meant that only one of the computers could be turned on at any one time. Thus, whilst technically there was one computer per class, in practice only 4 or 5 of these could be used at any one time. The quantity of computer equipment could best be categorised as low, with less than one functional machine per class or less than one computer per 40 children.

Each machine was accompanied by between 11 and 63 floppy discs. The discs contained a very large number of programs 'suitable' for children of primary school age, spanning drill and skill, simulations and adventure games, generic applications such as word processing and versions of LOGO. Thus there was a wide range of software, but it was poorly organised and of varying technical and educational quality. In addition there was no consistency between the different programs either in terms of the educational objectives they supported, the underlying models of learning on which they were based, the interface design, or the ways in which they operated.

Without exception the tables on which the computers were housed were cluttered with discs, documentation, paper, cables and various items of hardware (often not attached to the computer). There was seldom sufficient clear space for a child to place an exercise book.

The lack of reliability of the hardware was a problem that many of the staff commented upon:

> The main problem with using computers in schools was the technical problems relating to unreliability of the equipment
>
> (Mrs Smith, 9th November)

> Mr Jones … related a story about Mrs Smith last year losing a whole load of children's stories because the machine kept printing the first three lines then freezing. He said his computer worked for about 20 mins then froze and the children asked him what to do and he went to get the Y7 teacher who suggested turning it off and trying again later.
>
> (Field Notes, 3rd November)

> You know you should be working with it, you know you really want to but the blasted thing keeps breaking down on you.
>
> (Mrs Humphries, 30th November)

Thus the existing computer hardware in County School at the start of the research could be categorised as being of poor quality and low in quantity. The software was diverse and there was little or no consistency in interface design so that teachers had to learn how to operate each application 'from scratch'.

The additional equipment consisted of five Apple PowerBooks with Claris Works and one inkjet printer. These were added to each of the three case study classes in turn, giving a computer to pupil ratio of at least 1 to 6. In the context of the school's own resources, the quantity and quality of hardware and software provided as part of the research was high.

Case Study 1

Description of the first case study classroom (5DS)

The Case Study 1 class (5DS) was a Year 5 class (9 – 10 year olds) of 30 pupils. The class teacher (Mrs Smith) had been teaching for approximately six years. She held the post of responsibility for Mathematics within the school.

During the entire study 5DS had sole access to a BBC Master as well as shared access to an A3000. This provided the base line figure of 1.3 computers for 5DS.

At the start of the study Mrs Smith stated that she was relatively confident in her ability to use computers but felt that they were overrated as a means of teaching. She felt that when being used in the classroom they should be integrated into the curriculum; their main purpose should be as a tool to help children learn. Mrs Smith expressed concern that as the Mathematics co-ordinator she should be using IT because it was mentioned in the National Curriculum for Mathematics. She said she did not know about widely available software such as OURFACTS and was not sure what a spreadsheet was.

When Mrs Smith was first introduced to new equipment that was being added to 5DS she was given a brief (15 minute) period of instruction in its use. She was offered further training but declined it. It was made clear to her that she could use the equipment in any way she chose (or not at all).

Analysis of the quantity of computer use during Periods 1 to 6

Period 1 covered the second half of the Autumn term when 5DS had access to 1 BBC and shared access to an A3000. The class teacher reported that she used the computer with children roughly once per month in her response to the original questionnaire, which she completed in November. However this was not confirmed by any of the other data collected.

Analysis of the Manual Logs showed that during Period 1 the BBC and A3000 were used for a total of 60 minutes. This represented two sessions: one was a withdrawal session involving a special needs teacher and one child; the other involved a child who had forgotten to send her work home to the typing pool and thus had to copy type it herself. Sixty minutes over Period 1 was equivalent to an average of between one and two minutes of computer use per day.

It may be that the class teacher did not always fill in the Manual Logs and that it thus gives an underestimate of the actual level of computer use. However by mid October the BBC outside the classroom had not been set up (the distribution board was still in its wrapper) indicating that the BBC had not been used. This supports a statement made by the class teacher the following January that whilst there may have been BBCs in the school they were not used.

Additional evidence that the Manual Logs gave a reasonably accurate indication of the low level of computer use during this time came from the class teacher's weekly plans for the Autumn term which made no reference to any computer use. This was also supported by the fact that at no point during the observations made by the researcher was any child from 5DS seen using a computer during Period 1 of the study.

Period 2 covered the last week of the Autumn term and the first week of the Spring term. During this time 5DS had access to one PowerBook in addition to the BBC and shared A3000.

The Manual Logs indicated no computer usage during this time and there was no other evidence to suggest that the BBC or A3000 were used during Period 2. However the Automatic Log, which was more accurate than the Manual Logs as an indicator of the quantity of use of the PowerBook, indicated 731 minutes computer use. This level of use of the PowerBook was confirmed by the class teacher who identified that all of this use had taken place over the first five days of the Spring term, when the children were writing their New Year resolutions. 15 pieces of work that the children had completed on the PowerBook during this period were collected, providing additional evidence that the PowerBook had been used extensively.

Period 3 covered the first half of the Spring term. Analysis of the Manual Logs showed that during Period 3 the BBC was not used at all. There was no other evidence to suggest that the BBC or A3000 were used during this time. This view was supported by the researcher's observations; at no point during this period was any child from 5DS seen using the BBC or A3000. The Manual Logs showed that in this same period of time the five PowerBooks were used for a total of 3,955 minutes, including 210 minutes use by the class teacher at weekends. The Automatic Logs indicated that the five PowerBooks were in use for a total of 5,577 minutes. Given the greater accuracy of the Automatic Logs for PowerBook usage the quantity of use for Period 3 was taken to be 5,577 minutes. This represented an average of 279 minutes computer use per day.

Period 4 covered the second half of the Spring term, during which time 5DS had access to one BBC and shared access to an A3000. The Manual Logs indicated that the BBC was not used during this period. However it showed a total of 670 minutes use of the A3000 over six sessions.

This level of usage was corroborated by the class teacher's weekly plans, which indicated that the A3000 was to be used by small groups of children working with a parent from 11am to 12.15 every Wednesday. It was also supported by her statement, during an interview, that she intended to use a parent to work with the children on the A3000 every Wednesday in future (Mrs Smith, 7^{th} Feb).

The level of usage reported in the Manual Logs was more than could be accounted for by 60 minutes use once per week; indeed the Manual Logs showed the computers being used for more than 60 minutes on Wednesdays as well as some use at other times. On the basis that not all use was planned and that there was no evidence to suggest that the logs were filled in inaccurately the total level of use for this period was taken to be 670 minutes.

Period 5 covered the first six weeks of the Summer term. During this time 5DS had sole access to the five Apple PowerBooks as well as to their BBC and shared A3000. The researcher's field notes indicated that at no point was any use of the BBC or A3000 in evidence during this period. This view was supported by an analysis of the scheme of work and topic web, which showed no reference to computers. However the weekly plans for this period indicated that a parent helper was to work with children on IT on one occasion (Wednesday of the first week). Thus it seems reasonable to assume that the BBC and/or A3000 were used on at least one occasion. The length of the sessions on Wednesdays in Period 4, which were taken by the same parent, was generally more than 60 minutes. This has to be balanced against the lack of any other evidence of use of the A3000 or BBC; a figure of 60 minutes was thus taken as being a reasonable estimate.

The Manual Logs for the first half of the summer term were 'lost' and thus did not provide any information about computer use in this period. However, the Automatic Logs, which provided a more reliable indicator of levels of use for the PowerBooks, showed that during Period 5 the PowerBooks were used for a total of 3,858 minutes. Thus the total computer use for Period 5 was 3,918 minutes (60 minutes on the A3000/BBC plus 3,858 minutes on the PowerBooks).

The Automatic Log and the Researcher's field notes indicated that all the use of the laptops took place between the 9th and 20th of May. Thus in the first four weeks of the summer term there was little evidence of any computer use taking place. During the last two weeks the children used the computers to write material for two 'class books' and to produce a newspaper which involved word-processing and use of the spreadsheet (Field Notes 20th May; Mrs Smith, 15th June).

The Manual Logs for Period 6, which covered seven weeks at the end of the Summer term, indicated that the A3000 was used for a total of 230 minutes. This was supported by one entry in the class teacher's weekly plans towards the end of this period, which said "SP to finish publishing HAIKU poems on the Archimedes".

Analysis of the quality of computer use during Periods 1 to 6

This analysis uses the 'quality criteria' specified on Page 73.

There were only two instances of computer use during Period 1. Given this very low level of computer use it was concluded that computer usage had no opportunity to impact on the children's learning. The quality of computer use in Period 1 was therefore rated as poor (5).

Table 3.4 Summary of quality of computer use in Period 1

Criteria	Summary rating
Planned	Not by class teacher
Involving teacher	Not class teacher
Integral (real purpose)	No
IT or other subject focused	Unclear
Distributed or IT slots	Only 2 occurrences
Using full potential of IT	No
Overall	5 (Poor)

During the first five days of the Spring term, which constituted the majority of Period 2, extensive use was made of the one available PowerBook to write New Year resolutions. Mrs Smith's long term (termly) planning for the Spring term referred to an IT Mini Project with Laptops and included a separate sheet for this Mini Project, which identified that all children would use computers to present their New Year resolutions (see Figure 3.1).

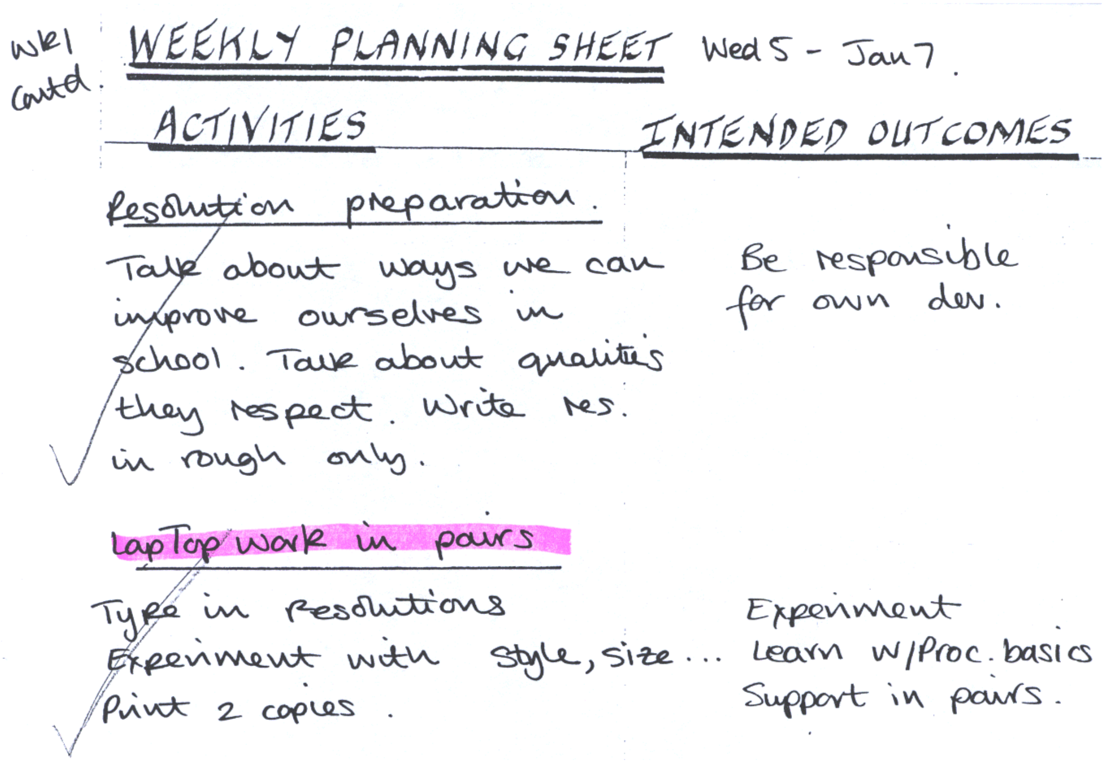
Figure 3.1 Extract from IT Mini Project on Laptops plan

All children to experience :—

a) Basic wordprocessing
change style and size of letters.
Print their own text. New Year Resolutions.

Mrs Smith's weekly plan for the first week of the Spring term indicated that the children would prepare their resolutions on the first morning of the term and would be given a demonstration of how to use the laptops. Further on in the same weekly plan fuller details were provided of both the preparation of the New Year resolutions and the use of the laptops (see Figure 3.2). Her weekly plan for the second week of the Spring term also mentioned the use of computers to write New Year resolutions. From this planning it was clear that the work on the computers during this Period was both planned and integrated with other classroom activities.

Figure 3.2 Extract from Mrs Smith's weekly plans (Wed 5th Jan – 7th Jan)



wk1 contd.

WEEKLY PLANNING SHEET Wed 5 - Jan 7.

ACTIVITIES	INTENDED OUTCOMES
Resolution preparation.	
Talk about ways we can improve ourselves in school. Talk about qualities they respect. Write res. in rough only.	Be responsible for own dev.
lapTop work in pairs	
Type in Resolutions Experiment with style, size... Print 2 copies.	Experiment Learn w/Proc. basics Support in pairs.

This view that the use of computers during Period 2 was integrated with other classroom activities was given further support by the description Mrs Smith provided of how the children had written their New Year resolutions:

> We had talked about resolutions at the start of the year. The children thought about what their resolution was going to be in rough. They would have had some notes - a few words or a sentence before coming to the screen – they had to know what the resolution was going to be before they went to the computer.
>
> The children checked spellings with me on screen or asked me how to spell words. They did not use the spellcheck.
>
> I gave them no input on layout or design.
>
> Each child spent roughly 30 minutes on their resolution.
>
> If the [additional] computers had not been present we would still have done something on resolutions. The children have their resolution in the front of their folders to remind themselves of it.
>
> (Mrs Smith, 24th Feb)

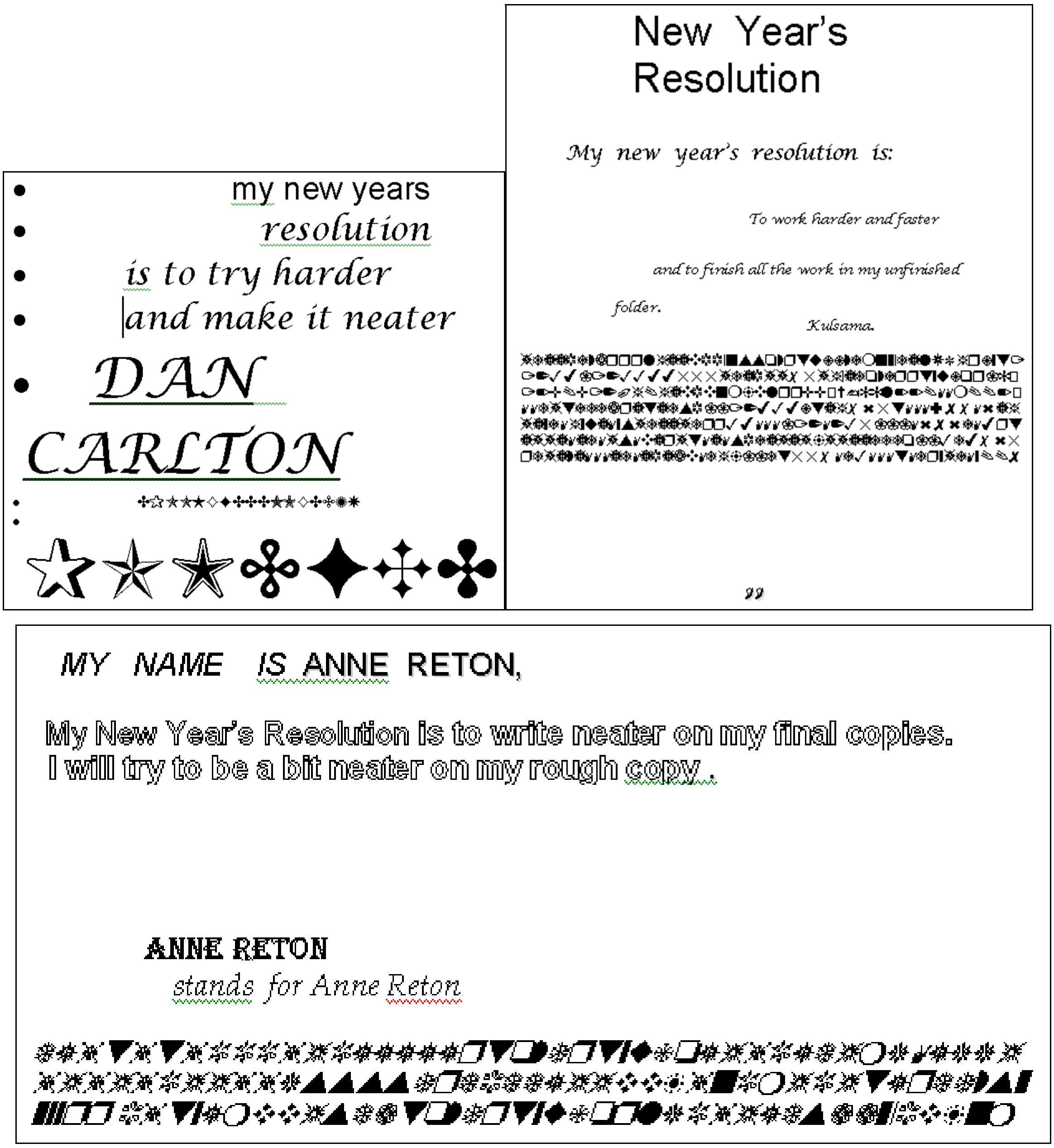
The weekly plan (Figure 3.2) and this extract from the interview both indicated that Mrs Smith played an important role in the activity by: leading a discussion of New Year resolutions, focused on how the children could take greater responsibility for their development in school; demonstrating how to use the computers; and then working with children as they used the computers to help them correct their spellings.

Mrs Smith's weekly plans (Figure 3.2) suggested that the main purpose of the computer use during this time was for the children to acquire computer skills. This view was supported by her comments during an interview. For example she said that she had run a whole class session on switching on and shutting down the computer and how to use the word processor and that:

> It was really an experiment to get used to the keyboard. A one off to get used to the computer.
>
> (Mrs Smith, 24th Feb)

Figure 3.3 demonstrates that the children edited their text (at least at the level of correcting their spellings) and reformatted their resolutions. Their work showed that they had learnt to use a range of features of the software including: changing the font (e.g. Anne Reton used Ariel, Monotype Sorts, Book Antiqua and Algerian); changing the font style (e.g. Anne Reton used plain text, italics and outline); and changing the font size.

Figure 3.3 Three examples of the New Year Resolutions for 5DS


my new years
resolution
is to try harder
and make it neater
DAN
CARLTON

New Year's
Resolution

My new year's resolution is:

To work harder and faster
and to finish all the work in my unfinished
folder.
Kulsama.

MY NAME IS ANNE RETON,

My New Year's Resolution is to write neater on my final copies.
I will try to be a bit neater on my rough copy .

ANNE RETON
stands for Anne Reton

The weekly plans indicated that the children were going to work in pairs on the laptop. Given that all 731minutes of computer use in Period 2 involved the use of just one PowerBook and occurred in the first five days of the Spring term suggested that the computer use was not limited to specific IT slots. However, the children were expected to have written notes about their resolution and to know what it was before they started using the computer, which suggested that they were not taking full advantage of the potential of the technology to enable them to draft and re-draft their work.

Overall the quality of the computer use during Period 2 was moderate (3). It was planned and integrated with other classroom activities. The teacher played an active role in supporting the children both before and during their use of the computer. The use of the computer was not restricted to IT slots. However, the activity was primarily focused on learning to use the software and the full potential of the technology to enhance the children's drafting, at the composition stage, was not utilised.

Table 3.5 Summary of quality of computer use in Period 2

Criteria	Summary rating
Planned	Yes
Involving teacher	Yes – Intro, demo, during use.
Integral (real purpose)	Yes
IT or other subject focused	IT
Distributed or IT slots	Distributed (limited to Art/Design)
Using full potential of IT	No
Overall	3 (Moderate)

The teacher's plans that cover Period 3 identified the use of the laptops as being a feature of this half term. They went on to identify 'IT Mini Projects' during which all of the children would: use a word processor to produce their New Year resolutions; use software to present pictures and text together; and use a data program (See Figure 3.4).

Figure 3.4 Extract from IT Mini Project on Laptops plan

All children to experience :—

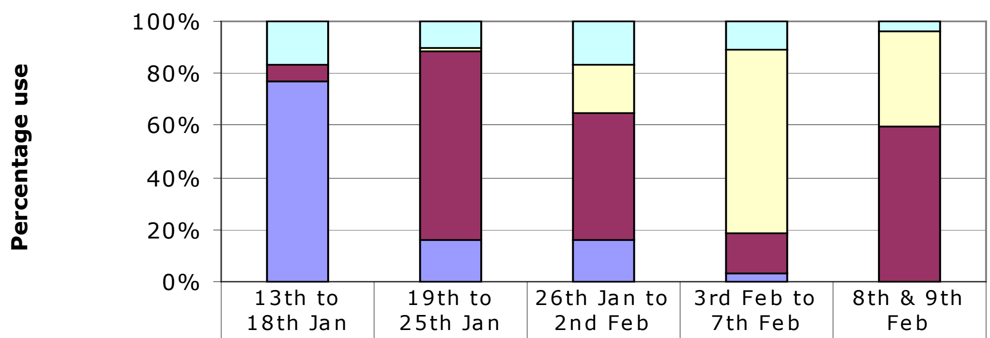
a) Basic wordprocessing
change style and size of letters.
Print their own text. New Year Resolutions.

b) Draw and text together
Make a book cover design (will colour & display in library)
either create or use existing book as guide

c) Use of data programme
– watch this space !!
"Spreadsheet". Enter simple data & make a pie chart, a histogram & a pictogram.
We will use the print outs for interpretation work.
They may present to each other?

The computer use in Period 3 did seem to have followed this pattern as illustrated below in Figure 3.5, which shows that the preponderance of computer use moved from word processing to painting to spreadsheets over the course of Period 3.

Figure 3.5 Percentage use of each application in 5DS during Period 3



	13th to 18th Jan	19th to 25th Jan	26th Jan to 2nd Feb	3rd Feb to 7th Feb	8th & 9th Feb
Other	17%	10%	17%	11%	4%
Spreadsheet	0%	2%	19%	70%	37%
Painting	6%	72%	49%	15%	60%
Word processing	77%	16%	16%	3%	0%

Time Period

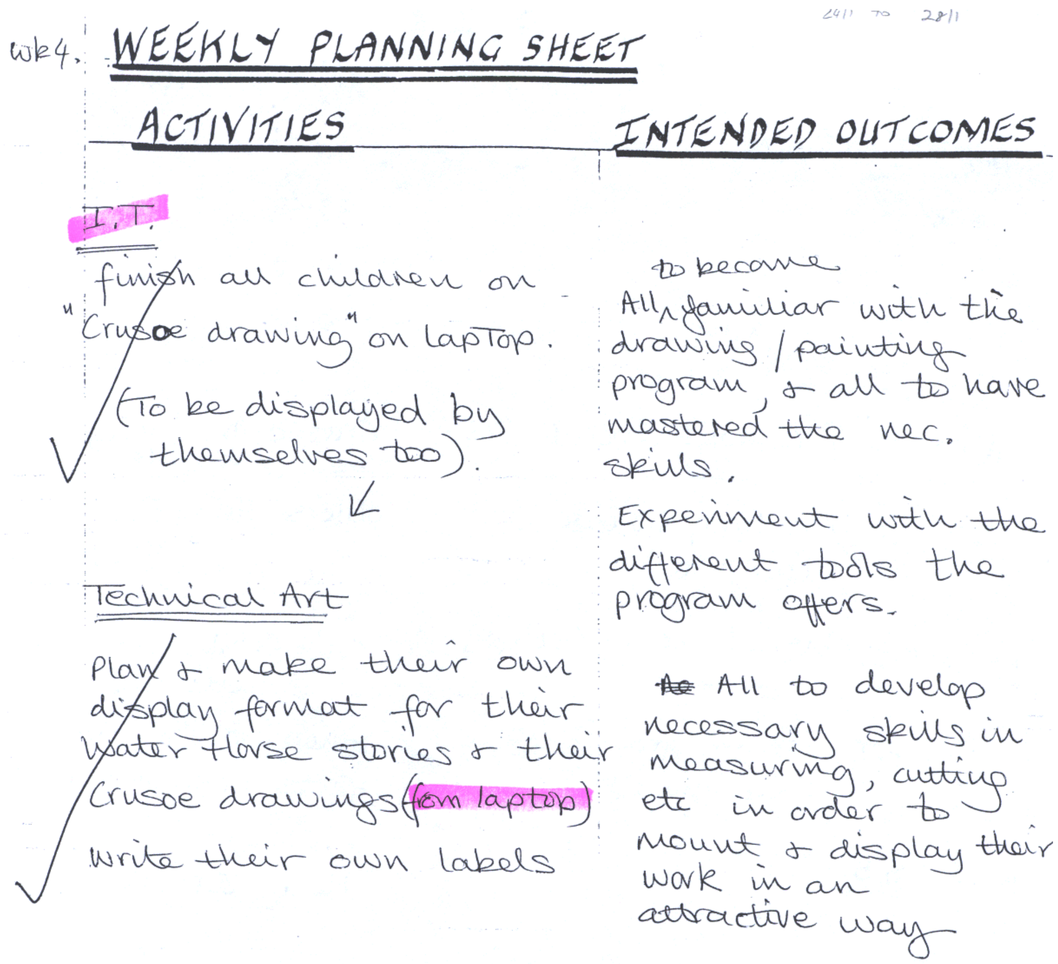
Thus, those children who had not already done so in Period 2 word-processed their New Year resolutions in the first part of Period 3. Figure 3.5 shows that the majority of computer work in the first week of Period 3 (ending on 18th Feb) was focused on word processing. This work was planned (as indicated in the discussion of the quality of computer use in Period 2), but unlike in Period 2 the level of teacher involvement seems to have been much less for this activity in Period 3. When working on their resolutions the children were

> left on their own to do it, but shared ideas with others who were also doing resolutions
>
> (Mrs Smith, 7th Feb).

As in Period 2, the main aim of this work seemed to be on ensuring that all the children were familiar with the basic features of using the word processing software. Mrs Smith said she had chosen to use New Year resolutions for the word processing in order to limit the length of the text the children would type (Mrs Smith, 7th Feb). This would have enabled the children to spend more time experimenting with the font styles and sizes rather than entering their text.

When all the children had completed their resolution on the computer the focus moved on to the use of the painting package, as indicated by the Teacher's plans (Figure 3.4), the Researcher's field notes, the Manual Logs and the Automatic Log (see Figure 3.5 26th Jan to 2nd Feb). The Teacher's weekly plans however do not mention the use of the painting software until the fourth week of term. The entry in the weekly plans for week 4 implied that this activity had already been completed by some children (see Figure 3.6).

Figure 3.6 Extract from Mrs Smith's weekly plans (Week 4)



2411 TO 2811

wk4. WEEKLY PLANNING SHEET

ACTIVITIES	INTENDED OUTCOMES
I.T.	
finish all children on "Crusoe drawing" on laptop. (To be displayed by themselves too).	All to become familiar with the drawing / painting program, & all to have mastered the nec. skills. Experiment with the different tools the program offers.
Technical Art	
Plan & make their own display format for their Water Horse stories & their Crusoe drawings (from laptop) Write their own labels	~~Ac~~ All to develop necessary skills in measuring, cutting etc in order to mount & display their work in an attractive way

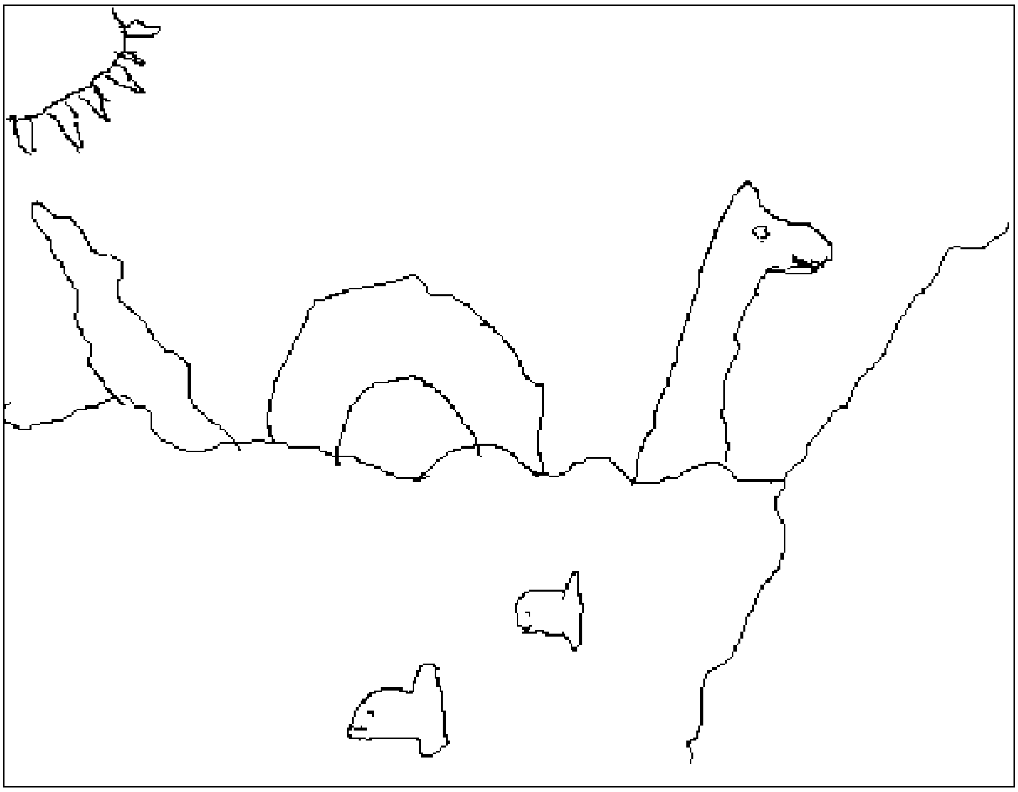
Each child in the class created a picture using the paint program. The pictures were linked to a story that the children had been reading in class and that they had all started to write their own versions of prior to doing their computer pictures (Mrs Smith, 7th Feb). Mrs Smith stated that the original aim of this activity was to design the front covers for the story books they were making (Mrs Smith, 7th Feb). Later on in that same interview she said that "Designing the front cover became a less significant aspect" (Mrs Smith, 7th Feb). The weekly plans (Figure 3.6) confirmed the view that the pictures were not going to be used as book covers, but were going to be put on display as part of a 'Technical art' activity. In either case, this use of the computers was integrated with other class work and as such was purposeful.

Mrs Smith's plans also made it clear that the focus of the activity was on learning how to use the painting program. This view, that the focus of the activity was on IT, was supported by the fact that at least some of the children had already painted a similar picture (with the same content and brief) using powder paints (Field Notes 25th Jan; Mrs Smith, 7th Feb). Thus, although the class teacher reported that the children did no rough work or initial designs of their pictures before coming to the computer (Mrs Smith, 7th Feb), it would appear that at least some of them were in effect 'copy typing' when they used the painting program. The integration of the computer use with other classroom activities therefore seems to have served the purpose of creating a context in which to learn how to use the software rather than being aimed at enhancing their artistic abilities or learning across the curriculum.

According to the Manual Logs most of the children had one session using the painting program, with 69 minutes being the average time taken. Given this and that it would have been the first time they had used the painting software, it seems likely that much of their attention would have been on learning how to operate it. This included learning how to load, save and print their pictures and how to use the pencil and undo tools. (See Figure 3.7 for an example of a typical picture from early in Period 3).

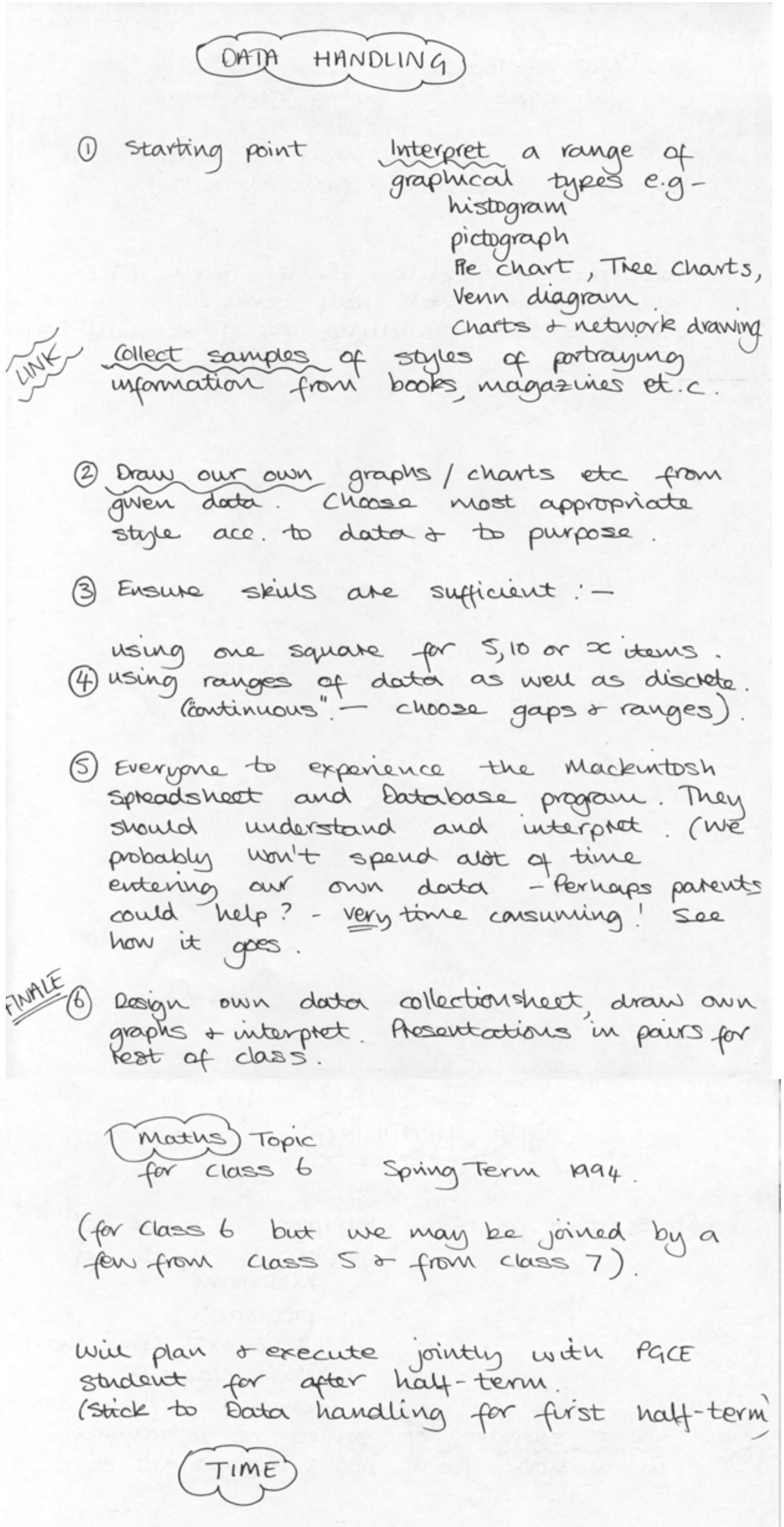
When all the children had completed their pictures on the laptops they went on to use the spreadsheet to generate bar charts and/or pie charts. Evidence for this came from: the teacher's IT Mini Project plans (Figure 3.4); the weekly plans for Week 4 (24th to 28th Jan), Week 5 (31st Jan to 4th Feb) and Week 6 (7th to 10th Feb); the researcher's field notes; the Manual Logs; and the Automatic Logs, which confirm that the use of spreadsheets started part way through Week 4 (see Figure 3.5).

Figure 3.7 An example of the pictures produced by the children in 5DS during the early part of Period 3



Mrs Smith introduced the activity to the first group; their brief was to generate a pie chart, histogram and pictogram (Mrs Smith, 7th Feb) using data which they had previously collected and which they had already used to generate bar charts by hand (Field notes 18th Jan). Mrs Smith spent about 15 minutes, showing them how to enter data and generate a chart (Field notes 2nd Feb). The children were then left to work individually on the computers while the teacher went to work with another group. Mrs Smith returned to see how they were getting on at regular intervals. Subsequent groups of children worked in pairs when doing this spreadsheet work and they only had to generate one type of graphical representation (Mrs Smith, 7th Feb). As was the case with the painting activity, Mrs Smith did play an active role in this activity, particularly at the beginning when she introduced it to the first set of children. Her role diminished over time, with most of her interaction being devoted to the children who were doing the activity first.

Figure 3.8 Mrs Smiths Data Handling overview planning sheet for the first half of the Spring term



DATA HANDLING

① Starting point Interpret a range of graphical types e.g –
histogram
pictograph
Pie chart, Tree charts,
Venn diagram
Charts & network drawing

LINK Collect samples of styles of portraying information from books, magazines etc.

② Draw our own graphs / charts etc from given data. Choose most appropriate style acc. to data & to purpose.

③ Ensure skills are sufficient :–

using one square for 5, 10 or x items.
④ using ranges of data as well as discrete.
("continuous". – choose gaps & ranges).

⑤ Everyone to experience the Mackintosh spreadsheet and Database program. They should understand and interpret. (We probably won't spend alot of time entering our own data – Perhaps parents could help? – very time consuming! See how it goes.

FINALE ⑥ Design own data collection sheet, draw own graphs & interpret. Presentations in pairs for rest of class.

Maths Topic
for Class 6 Spring Term 1994.

(for Class 6 but we may be joined by a few from Class 5 & from class 7).

Will plan & execute jointly with PGCE student for after half-term.
(Stick to Data handling for first half-term)

TIME

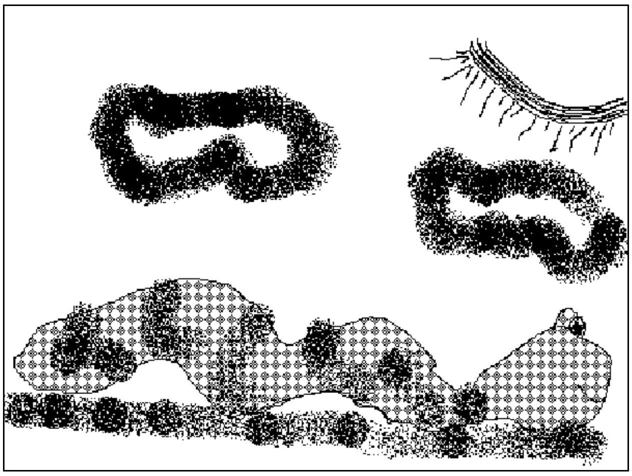
As with the painting activity, this data handling work was integrated with the children's maths work in the class. Data handling was one of the main themes for this term identified in Mrs Smith's medium term plans. Her overview planning sheet for data handling (Figure

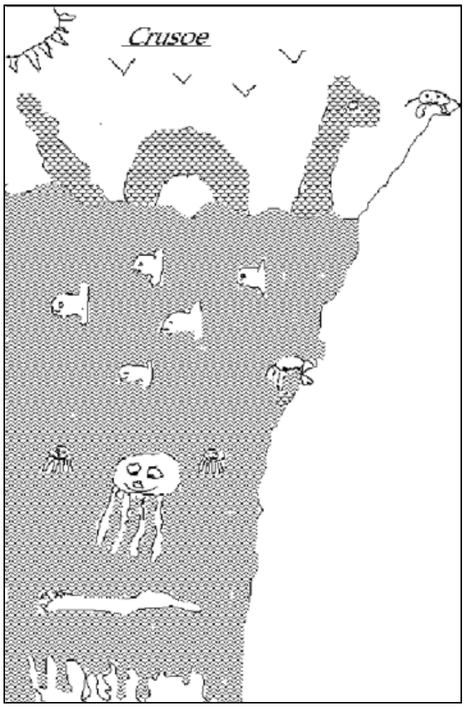
3.8) indicated progression from interpreting graphs that someone else had produced, through generating their own graphs by hand for different types of data, to using the computers to generate graphs which they could interpret. This is confirmed by the weekly plans which show data handling starting in Week 2, continuing in Week 3, and involving the children using the laptops for datahandling in Weeks 4, 5 and 6.

Mrs Smith's plans (Figures 3.8 and 3.4) indicated that the spreadsheet work would be focused on interpreting a range of different graphical representations. This intention was confirmed by Mrs Smith in an interview (Mrs Smith, 7th Feb). However, in practice the main aim of this spreadsheet work seemed to be for all the children to have a turn using the software. It was clear from the researcher's observations (Field Notes 2nd Feb) that Mrs Smith was unsure how to use the spreadsheet and that the children were having difficulties generating graphs and spent most of their time on entering the data and trying to operate the software. Mrs Smith's main role appeared to be on showing the children how to operate the software and helping them to solve (IT) problems as they arose. Later on in the interview on the 7th Feb Mrs Smith said that she did not know what they would do with the graphs and that the children had not had time to develop questions prior to working on the computers. Thus the children were generating graphs of data that they had already analysed by hand, without first having thought about what additional information the computer analysis would provide them with. As with the painting program, the children each had one session using the spreadsheet software, lasting an average of 51 minutes (according to the Manual Logs). Given the difficulties that Mrs Smith and the children were noted as having had with using the software to generate graphs, particularly pie charts, and printing out (Field notes 2nd Feb), it seemed likely that the main focus of this activity became using the software rather than interpreting data. There was no evidence to suggest that this work extended the children's understanding of data handling, though they clearly did become more competent at using the spreadsheet.

In the last week of Period 3, as all the children had finished their spreadsheet work, some of them returned to doing more work using the painting program. This appeared to have been unplanned – there was no reference to it in any of the teacher's plans. On the basis of the children's finished pictures, this work was an extension of their original work. The children appeared to have been working on the same files, experimenting further with features of the painting program such as fills, the airbrush and the text tools (see Figure 3.9).

Figure 3.9 Examples of pictures produced towards the end of Period 3 (The right hand picture is a later version of the one in Figure 3.7)





Overall it seemed that the full potential of the computers to support learning was not being utilised. The computer use during Period 3 was not evenly spread throughout the week, as illustrated in Table 3.6, which shows that the vast majority of computer use (around 80%) took place in the mornings, with over 60% of the total computer use in Period 3 taking place on Wednesday and Thursday mornings. This suggested that computers were not being fully utilised to enhance learning across the curriculum.

Table 3.6 Distribution of computer use (as a percentage of the total use) by 5DS during Period 3

% of total use in Period 3	am	pm	Day total
Monday	0	4	4
Tuesday	9	0	9
Wednesday	**28**	3	**31**
Thursday	**36**	10	**47**
Friday	5	0	5
Saturday	2	0	2
Sunday	1	3	4
am/pm Total	**80**	20	**100**

Similarly, even where the computers were being used their potential to enhance learning in other areas was not generally evident. This lack of impact on learning was predominantly because the focus seemed to have been on learning how to operate the software rather than using it as a vehicle for enhancing learning in other areas. There was one area in which the use of the computers did appear to have impacted on the children's learning. This related to the extent to which Mrs Smith expected the children to help and support each other throughout their use of the computers during Period 3. This was illustrated in her plans where she specifically mentioned 'supporting each other' as one of the aims of the children working in pairs. It also came out very strongly in the researcher's field notes and the interviews with the teacher. Thus for example, in the spreadsheet work Mrs Smith showed the first group how to use the software and told them that they would have to teach subsequent groups how to do it (Field notes 2nd Feb). Even more significantly, Mrs Smith reported that she had started to teach the children how to teach each other more effectively:

> We talked about how a good teacher would not touch the machine.
>
> (Mrs Smith, 7th Feb)

While there was evidence that prior to the addition of the computers the children had been expected to learn from each other's work there was no evidence of them having been asked to teach each other, yet alone being taught how to do so. It was clear from the class teacher's comments that teaching the children how to teach each other more effectively had arisen as a result of their use of the PowerBooks. This suggested that the use of the computers was enhancing the children's learning, though not in terms of other curriculum areas but in terms of learning skills *per se*.

Table 3.7 Summary of quality of computer use in Period 3

Criteria	**Summary rating**
Planned	Yes
Involving teacher	Yes – Intro, demo, during use, but reducing as children's familiarity grew. Teacher's role replaced by peer tutors.
Integral (real purpose)	Yes
IT or other subject focused	IT (but also learning about peer tutoring)
Distributed or IT slots	Use concentrated on Wed & Thur (am) – limited to English, Maths & Art/Design.
Using full potential of IT	No
Overall	3 (Moderate)

Six instances of the A3000 were recorded for Period 4. Mrs Smith's weekly plans indicated that the A3000 was to be used by small groups of children working with a parent from 11am to 12.15 every Wednesday.

The first instance of computer use in Period 4, which lasted 185 minutes, involved a parent working on the computer on her own with the aim of "familiarisation and prep of work with children" (Manual Log 10th Feb). This provided further support for the view that the work was planned.

The next four sessions involved small groups of children copy typing into a word processing program in order to "present their Haiku poems" (Manual Logs 22nd Feb & 2nd, 3rd, 9th Mar). Unlike in Period 1 where the use of the A3000 was due to a child having forgotten to send her work to the typing pool, these four sessions were planned. The children worked with the parent helper, who showed them how to operate the A3000 and supervised them as they were working outside the classroom. This computer use did not involve the teacher directly. This work was integrated with other classroom activities, in as much as the children were producing best copies of work they had written in the class and which were going to be included within a display in the classroom. However, as had been the case for most of the work in Periods 2 and 3, this seemed to have been more of a context in which to learn to use the computers rather than using the computers to enhance the children's language skills. The final session involved two children word processing a thank you letter (Manual Log 23rd Feb); it was not clear if this was copy typing or composing on screen.

As could be seen from the fact that the computer was only used on six occasions during this period the computers were not being used whenever they could enhance learning. This, along with the fact that much of the activity involved copy typing, indicated that the full potential of the technology was not being utilised.

Table 3.8 Summary of quality of computer use in Period 4

Criteria	**Summary rating**
Planned	Yes
Involving teacher	No – Parent working with children
Integral (real purpose)	Yes (to create display)
IT or other subject focused	IT
Distributed or IT slots	Only six instances of use
Using full potential of IT	No
Overall	5 (Poor)

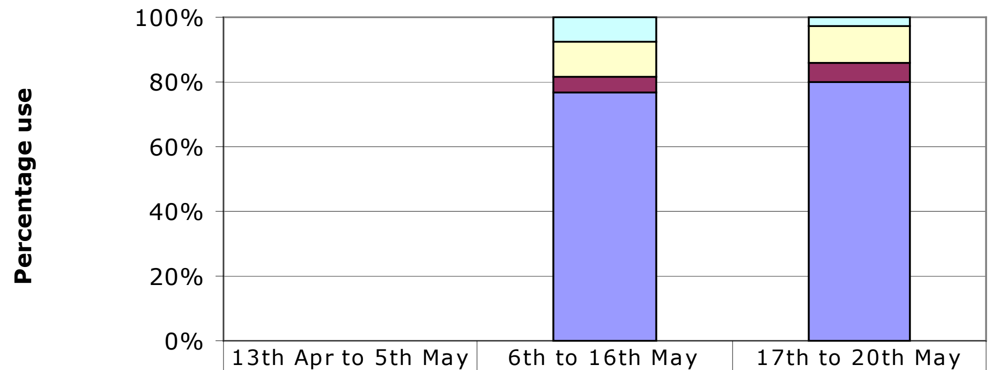
During Period 5, which covered the first six weeks of the Summer term, 5DS had sole access to the five Apple PowerBooks as well as to their BBC and shared A3000. Mrs Smith's medium term plans made no reference to any computer use during Period 5. However, the Weekly plans did make limited reference to use of the A3000 in the first week of term and to the use of the laptops in the fifth week of term.

Very little additional data was available about the use of the A3000, though the weekly plan indicated that it involved the same parent as had worked with children in Period 4.

Mrs Smith identified in an interview that she had "made an organisational step" in arranging for a parent to work with the children on the A3000 (Mrs Smith, 15th June). The plans for the second half of the summer term (Period 6) showed that this same parent was "to finish publishing Haiku poems on Archimedes". Thus it seemed probable that the parent carried on working with the children in Period 5, as she had been doing in Period 4.

The Automatic Logs indicated that the laptops were used extensively in the latter stages of Period 5, with the majority of the work involving word processing (see Figure 3.10). The field notes and an Interview with Mrs Smith (Mrs Smith, 15th June) confirmed that during the last two weeks of Period 5 the children used the computers to write material for two 'class books' using the word processor and to produce material for a class newspaper (mainly using the spreadsheet). However, there was only one reference to computer use in the Teacher's plans for this time, which suggested that over half of the computer use was unplanned. Indeed, Mrs Smith reported that the newspaper work was something the children had started when there was a supply teacher in the classroom for one day, but which then carried on for several weeks (Mrs Smith, 15th June).

Figure 3.10 Percentage use of each application in 5DS during Period 5



	13th Apr to 5th May	6th to 16th May	17th to 20th May
Other	0%	8%	3%
Spreadsheet	0%	11%	11%
Painting	0%	4%	6%
Word processing	0%	77%	80%

Time Period

The distribution of computer work over the last two weeks of Period 5 was more evenly spread than it had been in Period 3. This suggested that the computers were more closely integrated with other curriculum areas. Indeed, there was clear evidence that whilst the children were still acquiring new computer skills the main purpose of their computer use during Period 5 was on utilising the computer as a tool:

> They now have the basic skills and can start to benefit from the equipment.
>
> (Mrs Smith, 20th May)

> .... although they were getting so much more language learning out of it there was still a tendency to experiment on it. .... So it was really putting into practice what they'd already learned before and they were really ready to start doing it. .... Well, they were actually learning about language when they were doing it this time. They'd... They'd gone above the point of learning technically how the machine worked, now the machine was working for them, rather than being the other way round this time really.
>
> (Mrs Smith, 15th June)

It was also clear that the way in which the children used the word processor was different to its use in previous periods:

> This was different to what we'd done before because they actually used the thing as a blank page to start with and they actually wrote straight onto it. And they made their own editing and that as they were going on. .... It was enhancing language learning, it was making language learning more possible, they were actually doing this editing business and they were figuring out which lang... which words best said what they wanted it to say,
>
> (Mrs Smith, 15th June)

The implication was that the word processor was allowing them to focus on the content of their writing because of the ease with which it could be modified. This suggested that their use of the word processor was altering the way in which they were writing because, as the teacher pointed out,

> it was a great way of being able to make a mistake without it being permanent.
>
> (Mrs Smith, 15th June)

Thus the children were practising their writing skills but the way in which they were writing was changed as a result of using the computers. This indicated that much greater use was being made of the potential of the machines.

When the children were using the spreadsheet they collected data on paper, which they then entered into the computer in order to generate graphs (Mrs Smith, 15th June). Unlike their spreadsheet work in Period 3 they did not analyse the data by hand, but used the computer to generate all their graphs. Thus the level of integration of the computer use in this activity was greater than had been the case when they were generating graphs in Period 3. However, the class teacher was unconvinced that using the spreadsheet had extended their mathematics as much as using the word processor had done:

> I'm not so convinced about the data handling stuff, I'm not totally sure what they learned, mathematically, by doing that. I'm really not convinced that they've actually got very much further than they were before, I mean, it was lovely to see it and it was lovely to be able to get that on the screen, and it was great, but I'm actually convinced that it should help particularly their high priority ability mathematically.
>
> (Mrs Smith, 15th June)

As in Period 3, a striking feature of the computer use during this time was the extent to which the children were involved in peer tutoring. The degree to which the class teacher was continuing to teach the children how to teach each other was emphasised in the final interview:

> and we've had discussions about it and we've said that if you're a good teacher you wouldn't be touching the buttons. You would be ensuring that your pupil would be doing all the touching and you would be there as a safety net for that person. You wouldn't be telling them everything to do, you would be actually making sure that they can operate independently.
>
> (Mrs Smith, 15th June)

Thus, not only was the use of ICT enhancing the children's learning in English but it was also leading to a change in the curriculum, which placed greater emphasis on the children learning how to peer tutor.

Table 3.9 Summary of quality of computer use in Period 5

Criteria	Summary rating
Planned	Partially – some unplanned work
Involving teacher	Partially – supply teacher
Integral (real purpose)	Yes
IT or other subject focused	Use as tool and enhancing learning in English and peer tutoring
Distributed or IT slots	Distributed throughout last two weeks (used in English and Maths)
Using full potential of IT	Yes (at least in English)
Overall	2 (Good)

Mrs Smith had organised for a parent to work with the children on the A3000 on a regular basis during Period 6, as identified on Page 4.23. Further evidence for this came from one entry in her weekly plans towards the end of this period, which said "SP to finish publishing HAIKU poems on the Archimedes". However, the Manual Logs for this period, which indicated that the A3000 was only used by children on two occasions, made no mention of the parent helper. One of the entries did however identify that the aim of the activity was to produce a best copy of a Haiku poem. Thus it seemed reasonable to conclude that the A3000 was used on one occasion during Period 6 in much the same way as it had been used in Periods 4 and 5, to copy type a Haiku poem, with the assistance of the parent helper.

The Manual Logs indicated that the other instance of children using the A3000 in Period 6 involved two children writing a letter to a sugar factory asking for information. No other data was collected about this, and thus it is impossible to draw conclusions about the quality of this computer use.

The Manual Logs for the Case Study 3 class indicated that children from 5DS were going to the Case Study 3 class during this time to help them to use the laptops. The focus of this use was on the children from 5DS teaching the children from 2BH how to use the laptops.

Thus, the children from 5DS were putting into practice both their IT skills and their skills in peer tutoring.

Despite the lack of detailed data about the use of computers in 5DS during Period 6 it seems reasonable, given the low level of computer use throughout Period 6, that full use was not being made of IT to enhance children's learning and that its potential was not being realised.

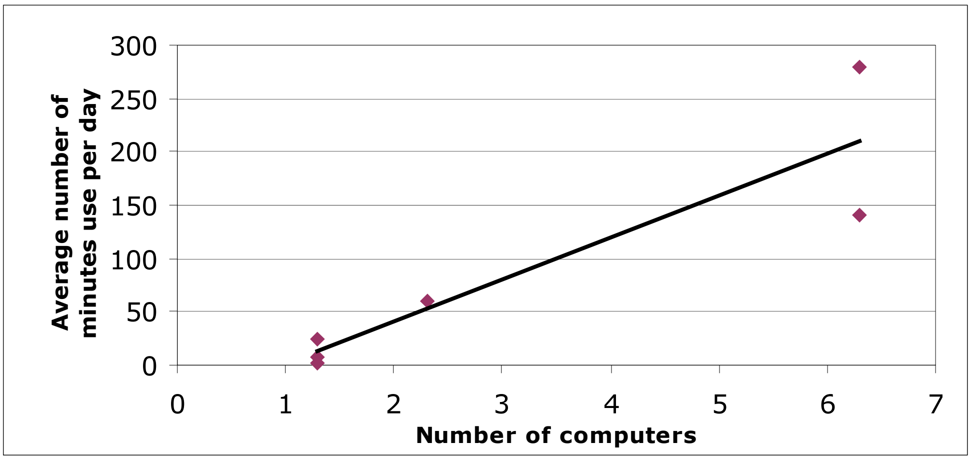
Table 3.10 Summary of quality of computer use in Period 6

Criteria	Summary rating
Planned	Partially – some unplanned work
Involving teacher	Unclear & very limited use
Integral (real purpose)	Unclear & very limited use
IT or other subject focused	Unclear though some peer tutoring
Distributed or IT slots	No
Using full potential of IT	No
Overall	5 (Poor)

Analysis of the extent to which the data from 5DS fitted the hypotheses

Analysis of the quantity of computer use against the number of computers (Figure 3.11) indicated that there was a relationship between the number of computers and the quantity of computer use in this case study. When 5DS had access to 1.3 computers (their baseline figure) the average quantity of computer use was low, between approximately 2 and 24 minutes per day. With the addition of one PowerBook the average quantity of use increased to approximately 61 minutes per day. With the addition of 5 PowerBooks (in total) the average quantity of computer use increased to between 140 to 279 minutes per day.

Figure 3.11 Relationship between the number of computers and the quantity of computer use in 5DS

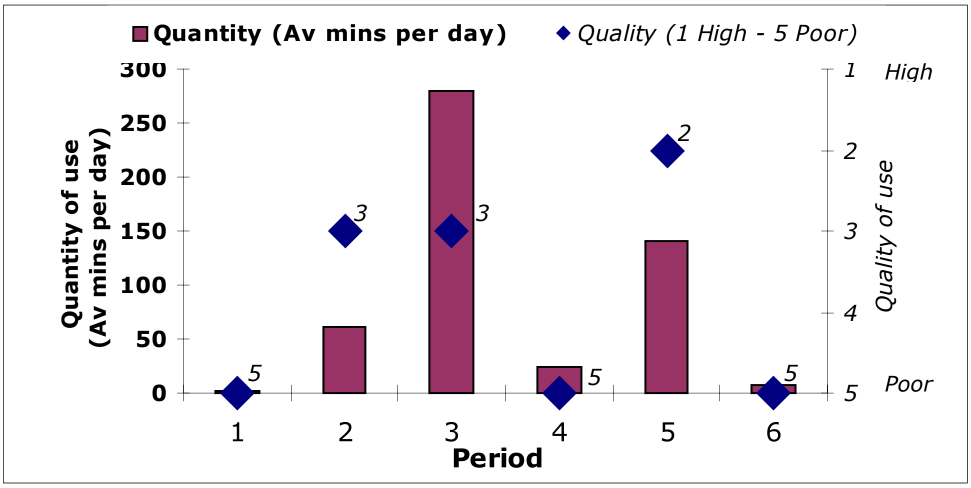


This suggested that the quantity of computer use in 5DS did increase when 5 PowerBooks were added. However, 5DS made little or no use of the 5 PowerBooks for the first four weeks of Period 5, which suggested that there was not a simple relationship between the quantity of computer use and an increase in the quantity and quality of computer resources. Further evidence for this came from an informal interview with Mrs Smith in which she noted that she would not have let the computers dominate so much in Periods 3 and 4 if they had been a permanent addition to the class, rather than being on loan for half a term

(Mrs Smith, 7th Feb). This might help to explain the substantial difference in the quantities of computer use in Periods 4 and 5 when 5DS had access to the 5 PowerBooks. Thus, whilst in this case study there did appear to be a relationship between the quantity of computer use and the addition of the PowerBooks, this was not a simple causal relationship. Therefore, increasing the quantity and quality of computer resources does not necessarily increase the quantity of computer use, and other factors need to be taken into consideration.

Figure 3.12 plots the quantity and quality of computer use in 5DS during each Period. This analysis provided some support for the view that increases in the quantity of computer use were associated with increases in the quality of use.

Figure 3.12 Comparison of the Quantity and Quality of Computer use in 5DS



When the quantity of computer use was below 30 minutes per day the quality of computer use was poor. As the quantity of computer use increased above 60 minutes per day the quality also increased. Furthermore, following fairly extensive use of the computers in Periods 2 and 3 the quality of computer use rose even further in Period 5. This was despite the fact that the quantity of computer use was higher in Period 3 than in Period 5. One possible explanation for this was that during Periods 2 and 3 the children were learning how to operate the computers, and thus were not gaining maximum benefit from them.

Whilst in Period 5, having already learnt how to operate the computers in the previous Periods, the children were then able to make greater use of the computers' potential to enhance their learning. Indeed, the discussion of the Quality of Computer use in Periods 2, 3 and 5 suggested that this was the case.

Thus, the evidence from 5DS did suggest that there was a relationship between the quantity of computer use that children have experienced over time and the quality of their subsequent computer use, assuming that the quantity of use remains above a minimum level.

The evidence presented so far did not show any association between increases in the quality of computer use and further increases in quantity of use in 5DS. Thus, for example, the quantity of use in Period 5 was less than that in Period 3. This seemed to suggest that the hypothesis was flawed. However, it might be that the design of the case studies was such that they could not provide an adequate response to this question. It was clear, as highlighted in the discussion of the impact of the 5 PowerBooks on the quantity of computer use, that Mrs Smith allowed the computers to dominate during Periods 2 and 3, in the belief that 5DS would only have them for a short timespan. In Period 5, when she had the five PowerBooks for a second time, she noted that they represented less of "an extreme novelty that every body was watching" (Mrs Smith, 15th June) and she did not let them dominate so much, at least initially. This suggested that a case study design that involved the permanent addition of 5 PowerBooks might have provided more valid data.

Support for the view that an increase in the quality of computer use would at least sustain, if not increase, the quantity of use came from an observation that Mrs Smith made in an interview during Period 6:

> The kids got... The kids loved it so much, that has to be a factor really. They were so motivated to use them and that's got to be worth harnessing really if they... if they can apply the same motivation with that to the Archimedes and to the other computers.
>
> (Mrs Smith, 15th June)

This shows that Mrs Smith was keen to harness the children's motivation, particularly in the light of the educational benefits that she had seen coming from the computer use in Period 5 (see discussion of the Quality of computer use in Period 5 above). Whilst it was impossible to predict what would have happened if 5DS had been able to keep the laptops indefinitely at the end of Period 5, it seemed likely that they would have become embedded in the normal classroom routines:

> If I could have them permanently, I would... I would write it in with my..., I mean, it would be part of my language work all the time. A group would be using them every week as their language task and then another group would do it another week or something, so it would be an integral part of the language stuff.
>
> I'd have to explore the options a lot more to see what I was going to do with it mathematically, but certainly language-wise the word processor would be an integral part of the language work that they did.
>
> (Mrs Smith, 15th June)

Case Study 2

Description of the second case study classroom (4JJ)

The second Case Study class (4JJ) was a Year 4 class (8 and 9 year olds) of 32 pupils. The class teacher, John Jones, had been teaching for approximately four years, one year of which was at County Primary School. He was a Music specialist and held posts of responsibility for Music and Key Stage 2 Science. In addition to the class teacher a nursery nurse was available to 4JJ on two mornings per week. During the periods of the case study 4JJ had sole access to a BBC Master as well as shared access to an A3000. This provided the base line figure of 1.3 computers.

At the start of the study Mr Jones stated that he had not had any IT INSET and did not feel confident about using computers. He also indicated, in his response to the initial questionnaire, that he rarely used a computer with children and never used one at home. However, he said that he did feel that computers should be used for teaching across the curriculum (ITTE Questionnaire 30th October; Mr Jones, 10th November). Though he did not necessarily see this as meaning that computer use had to be integrated with other work in the classroom:

> So I don't see that that's a problem if it can be integrated into you know what's actually happening but I don't see that it always has to I don't see that there's a problem
>
> (Mr Jones, 10th November)

Mr Jones also indicated that he did not think that teachers needed to be able to use the computer very well so long as they had basic problem solving techniques; the important issue was that the children could use the computers well.

Mr Jones	I see the most important thing is that the children really know how to use them I don't see that we [teachers] should know how to use them ... I don't think that we [teachers] have to be able to use them incredibly marvellously.
Researcher	Right
Mr Jones	I think we [teachers] need a basic survival kit.

(Interview, 10th November)

The impression the researcher gained from his interactions with Mr Jones during their initial meetings was that Mr Jones felt a conflict between the pressure he felt under to use IT (from the National Curriculum, the head teacher and the research) and his own personal feelings about it.

Analysis of the quantity of computer use in 4JJ during Periods 1 to 4

Period 1 covered the second half of the Autumn Term, whilst Periods 2 and 3 covered the first half of the Spring Term. During this time 4JJ had access to one BBC Master and shared access to an A3000. Mr Jones stated that half the children in the class had each spent 20 minutes using 'Trains' on the computer during the first half of the Autumn term (Mr Jones, 10th Jan), prior to Period 1. Whilst the majority of the children in 4JJ who were asked said that they had not used a computer since the previous class (i.e. the previous academic year) one or two of the children said that they had used 'Trains' during the Autumn term (Children in 4JJ, 7th Feb). This seemed to confirm Mr Jones's reported use of the BBC prior to Period 1 starting.

At the beginning of Period 1 the BBC Master in 4JJ was connected to a monochrome (Green) monitor which had a very bad flicker that rendered it unusable (Field Notes 12th Oct). Some six weeks later the computer had been swapped, but Mr Jones said that there had then been a problem with the printer, which meant that he had not been able to use it. He had swapped the printer but had not tried to use it since (Field Notes 30th Nov). Very near the end of Period 3 children from 4JJ said that they didn't think the computer was working (Field Notes 7th Feb). This suggested that the BBC Master was not used during Periods 1 to 3.

Indeed, there was little evidence of any computer use during this time span. In the planning covering Periods 1 to 3 IT was referred to in three places: the Schemes of work for Period 3 contained one reference to IT subsumed within the National Curriculum requirements for Maths; the topic webs for all three periods contained the phrase 'Use of IT' or 'IT Database' under the heading Maths; and the cross-curricular themes planning sheet for the year contained the entry 'Database – if computer will load' under the Autumn term, followed by an arrow pointing to the Spring term. Copies of these same topic webs and cross-curricular themes planning sheets that were collected during Period 4 indicated that this work had been transferred to Period 4 and did not take place during Periods 1 to 3. In addition the weekly planning sheets for Periods 1 to 3 made no reference what so ever to computer use.

Mr Jones said in an interview near the beginning of Period 2 that:

> "I haven't done any [computer work] this year with them"
>
> (Mr Jones, 10th Jan)

This was corroborated by the children in 4JJ who reported (Children in 4JJ, 7th Feb) that they had not used the computer for a long time, certainly not during the Spring Term. Some of the children thought they had not used a computer since the previous academic year.

The view that little or no computer use had taken place during Periods 1 to 3 was further supported by the Manual Logs, which indicated a total of 30 minutes of computer use during this time span. Additional evidence for the low level of computer use in 4JJ during this time came from the researcher's field notes. These indicated that the researcher did not see any evidence of computers either being, or having been used by children in 4JJ at any point during Periods 1 to 3. The estimated quantities of computer use during Periods 1 to 3 are summarised in Table 3.11.

Table 3.11 Quantity of computer use by 4JJ during Periods 1 to 3

Period	Total use (mins)	Average minutes per day
1	0	0
2	0	0
3	30	1.5

Period 4 covered the 2nd half of the Spring term, when the five Apple Powerbooks were available to 4JJ. The Manual Logs and researcher's field notes supported the view that the BBC and A3000 were not used at all during this time. However the researcher observed the Powerbooks being used by children from 4JJ on two of his visits to the school during Period 4. The computer logs indicated that the PowerBooks had been used during this time: the Manual Logs recorded 3,123 minutes of use during Period 4 compared with the Automatic Logs which showed 2,970 minutes use.

Additional evidence for this increase in the amount of computer use in Period 4, compared with Periods 1 to 3, came from the planning for this time: the topic web for Period 4 listed 'IT Database - Spreadsheets' under maths; the 'Cross-curricular themes' sheet for this time indicated that the database work listed under the Autumn term had been moved to Period 4 and would consist of working on spreadsheets using the laptops (i.e. the additional equipment being provided as part of the case study); and the weekly planning sheets for three of the weeks during Period 4 listed activities involving the computer (21st-25th Feb: Word processing; 28th Feb -4th Mar: Drawing Package; 7-11th Mar: Spreadsheets).

Given the greater accuracy of the Automatic Logs than any of the other indicators the quantity of usage for Period 4 was taken to be 2,970 minutes, an average of 106 minutes per day.

Analysis of the quality of computer use in 4JJ during Periods 1 to 4

This analysis uses the 'quality criteria' specified on Page 73.

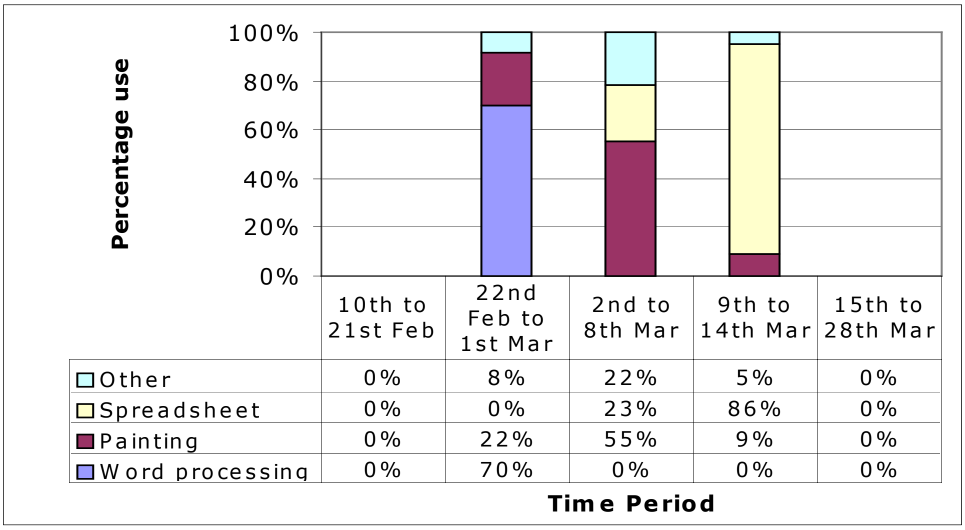
Given that there was no computer use in Periods 1 and 2 the quality of use in those two timespans was taken to be poor. There was only one instance of use of the BBC during Period 3. This involved two boys using a simple adventure program called Treasure Hunt for the last 30 minutes of a Thursday afternoon. All the available evidence pointed to this being an unplanned, one off use of the computer. There was no reference to it in Mr Jones' plans and two days earlier he commented to the researcher that "We've been without a computer for a couple of weeks, but now that it's back I'm sure it will get used at some stage." (Field Notes 18th Jan). The timing of the activity, at the end of the afternoon session, also suggested that it was a 'filler' for the two boys once they had finished their other work. The nature of the activity would have meant that there was little learning about IT involved. Thus any learning that did take place would have been in another subject area. Given that this was the only instance of computer use during Period 3 it is clear that IT was not being used whenever it could enhance learning and that the full potential of IT was not being utilised.

Table 3.12 Summary of quality of computer use in Periods 1 to 3

Criteria	Summary rating
Planned	No
Involving teacher	Unclear & very limited use
Integral (real purpose)	No
IT or other subject focused	Other subject (but very limited use)
Distributed or IT slots	Only one instance of use
Using full potential of IT	No
Overall	5 (Poor)

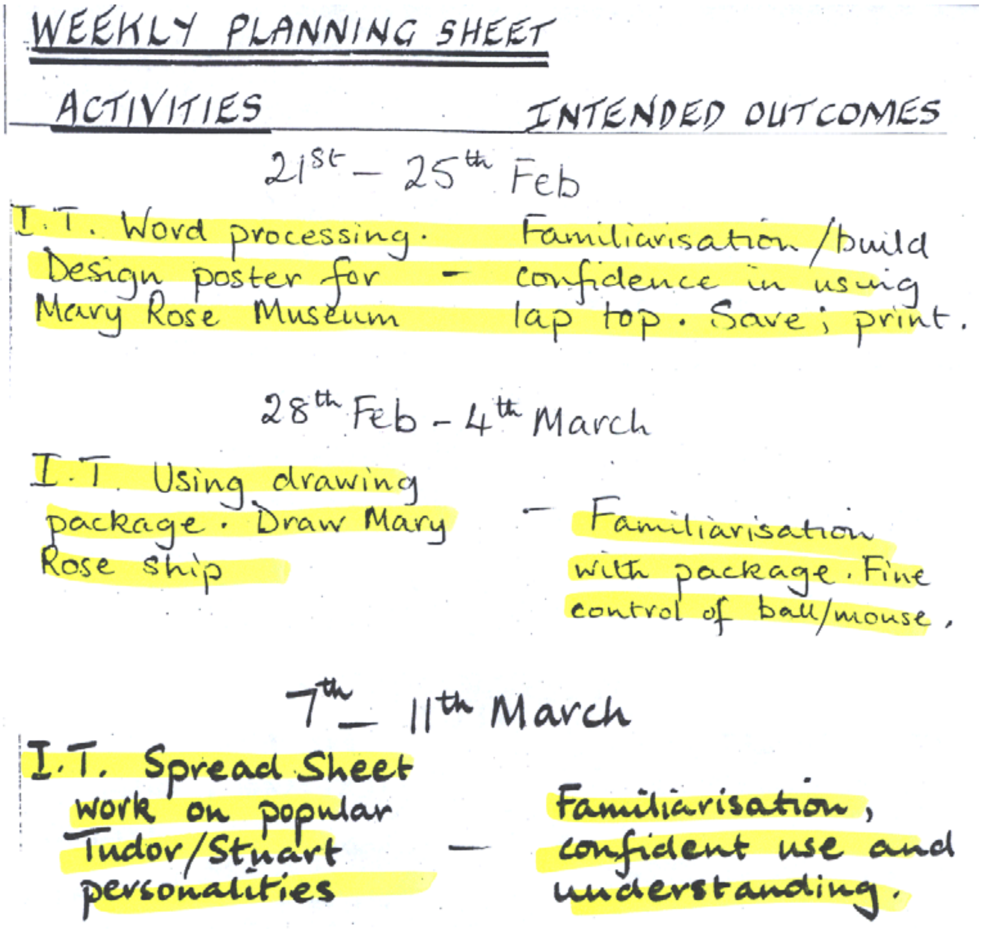
Mr Jones said that he had shown some of the children how to use the computers in the first week of Period 4 (Mr Jones, 28th Mar), this was not confirmed by the Automatic Log. Mr Jones also indicated that he did not plan to use the computers in the week beginning the 14th Mar (Mr Jones, 28th Mar; Field notes 8th Mar), which was confirmed by the Automatic Log. Thus all of the computer use took place in a three week period in the middle of Period 4 (see Figure 3.13), which corresponded to the first three weeks of the second half of the Spring term.

Figure 3.13 Percentage use of each application in Period 4, based on the Automatic Logs



As indicated in Figure 3.13, the computer use focused on word processing, then painting and finally spreadsheets. This followed the sequence of activities mentioned in the weekly planning sheets (see Figure 3.14).

Figure 3.14 Extracts from Mr Jones' weekly planning sheets



WEEKLY PLANNING SHEET

ACTIVITIES	INTENDED OUTCOMES
21st – 25th Feb	
I.T. Word processing. Design poster for Mary Rose Museum	– Familiarisation / build confidence in using lap top. Save; print.
28th Feb – 4th March	
I.T. Using drawing package. Draw Mary Rose ship	– Familiarisation with package. Fine control of ball/mouse.
7th – 11th March	
I.T. Spread Sheet work on popular Tudor/Stuart personalities	– Familiarisation, confident use and understanding.

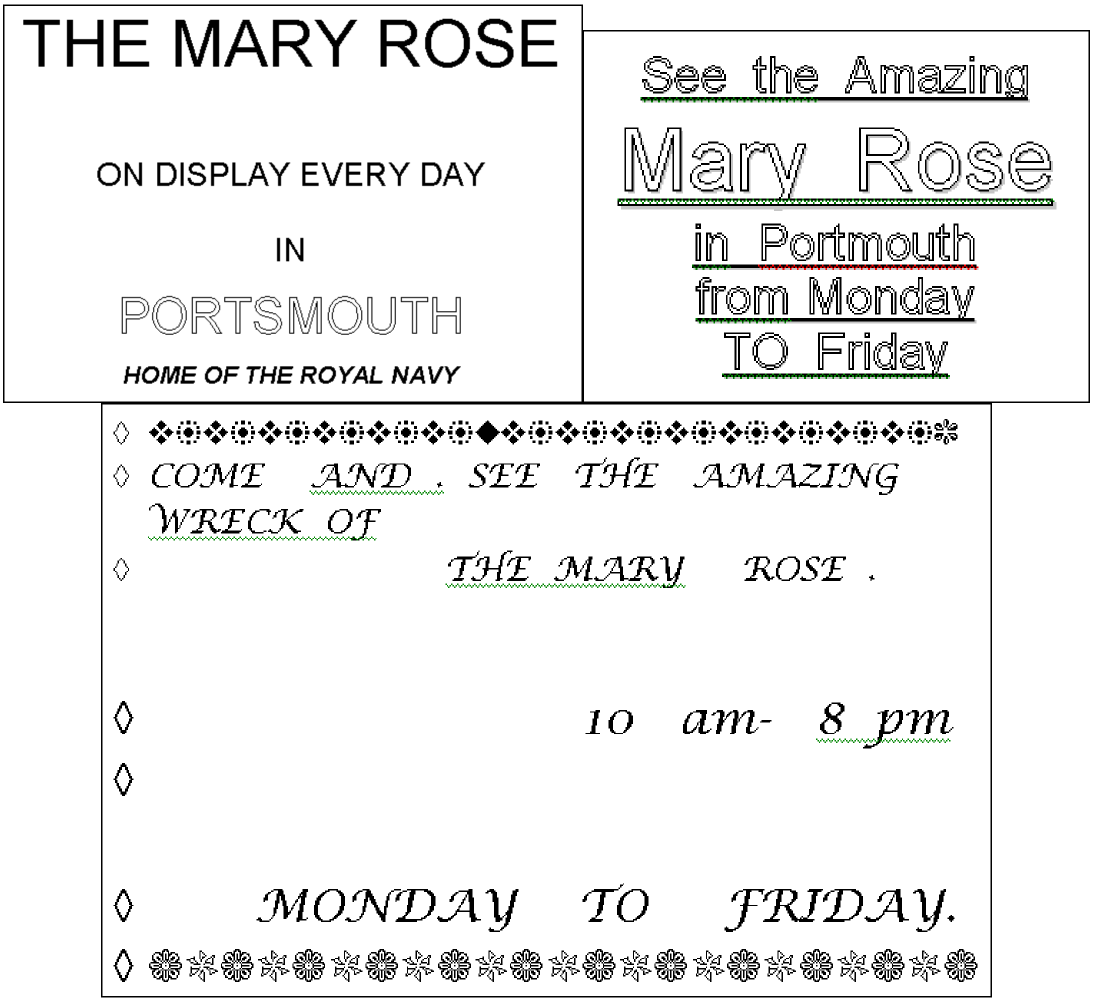
The word processing involved designing a poster related to a trip the children had made to the Mary Rose Museum. Thus it was integrated with their other school work in as much as that set a context for the 'poster'. The children undertook this work in the dining area outside the classroom, under the supervision of the nursery nurse. Mr Jones had no direct involvement in the activity once it had started. Both Mr Jones and the nursery nurse indicated that the aim of the activity was to develop the children's IT skills:

> The intended outcome was to develop their competence in using word processing skills.
>
> (Mr Jones, 28th Mar)

> Basically making sure everyone knew how to start it up and things like how to start in the centre for a poster and they sort of experimented with size of the script and different styles of script and some of them who had used a computer before did fancy bits and patterns and things.
>
> (Nursery Nurse, 3rd May)

Samples of the children's work (Figure 3.15) showed that the language content involved in this activity was minimal both in terms of the amount and nature of the text. The finished products demonstrate that the children had learnt to use a range of fonts, font styles and formatting features such as centring text, suggesting that the main focus was on experimenting with the features of the software rather than on enhancing their English or design skills.

Figure 3.15 Samples of the word processing produced by 4JJ



Once all of the children had completed their word processing they then moved on, in the following week, to use the painting program. Again this took place in withdrawal groups led by the nursery nurse. The children worked in pairs on the computers, drawing a picture of the Mary Rose. The nursery nurse had prepared a worksheet, which showed a series of diagrams illustrating how to build up a complete picture (Figure 3.16). By 'copying' each diagram in turn onto the computer the children built their pictures up in layers.

Figure 3.16 The worksheet for the painting activity

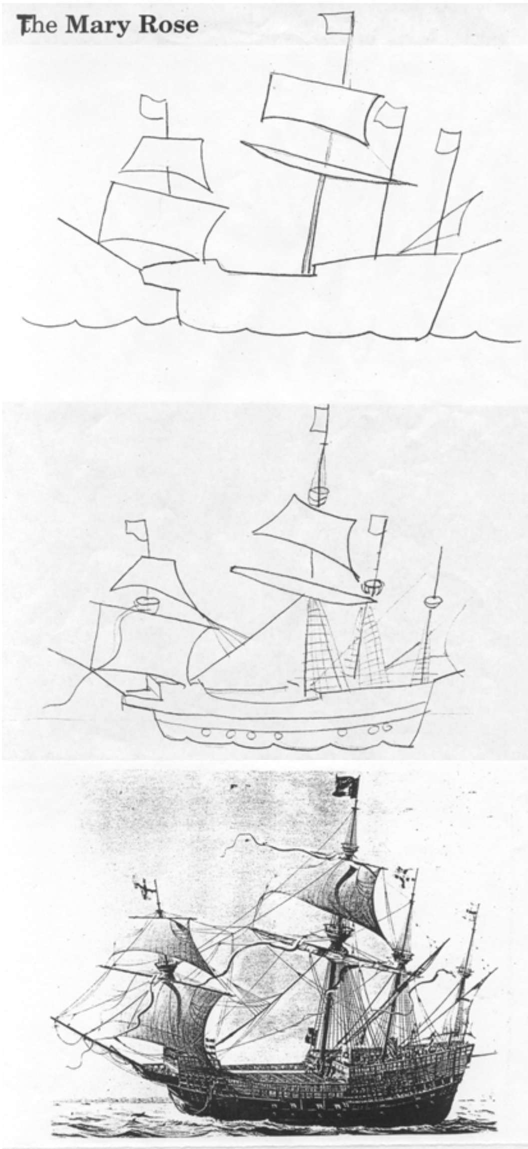
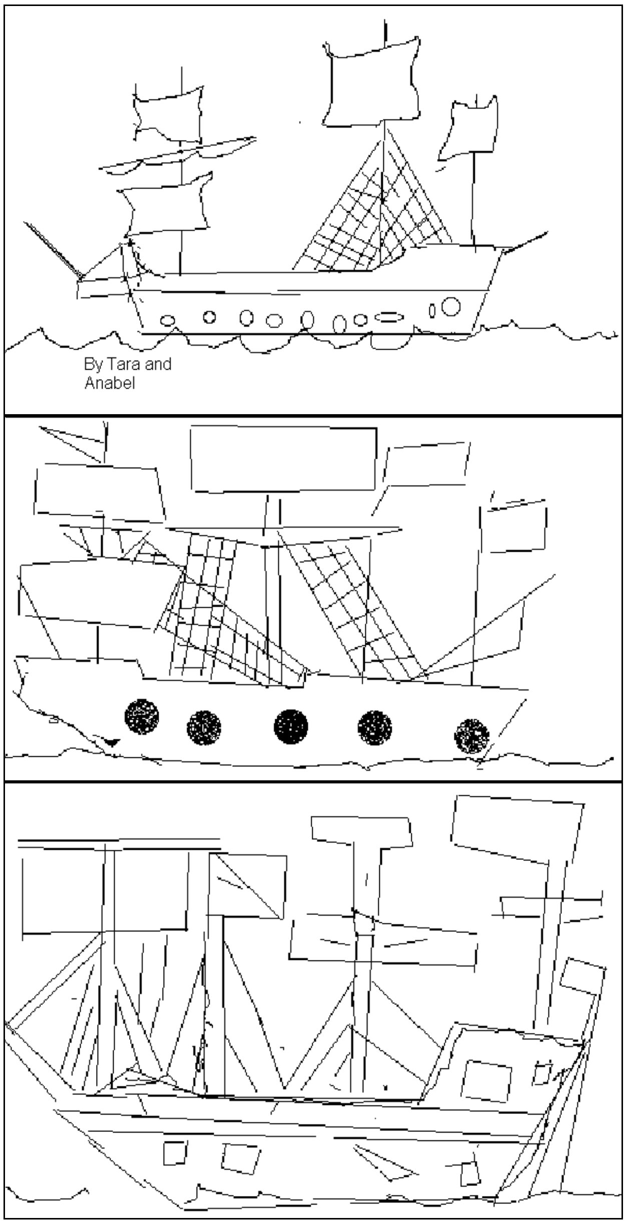


Figure 3.17 Samples of the paintings produced by 4JJ



Here too the focus seemed to have been on learning how to operate the software (Mr Jones, 28th Mar). However, it was clear from the detail in the finished pictures that the children produced (Figure 3.17) that the structuring of the activity had focused the children's attention on drawing the ship rather than on experimenting with a wide range of features of the software. They were, at least implicitly, learning a common technique for painting by simplifying the picture and building up the complexity gradually. Thus whilst the stated aim of the activity was to develop their IT skills it seemed likely that they were also learning about Art at the same time.

The final activity, which each child moved on to in the following week, was to use the spreadsheet to generate a bar chart. Mr Jones organised a class vote on who was the most popular Tudor, prior to sending groups of children out to the shared area to work with the nursery nurse on the computers. Thus Mr Jones did play a role in preparing the data that the children were going to use, but he played no direct role in their actual use of the computers. This activity, whilst set in the context of the main theme for the term (Tudors and Stuarts), did not seem to be integrated with any other classroom activities. Thus, for example, their mathematics work around this time did not involve any data handling.

All the children used the same set of data, which pairs of children entered into the spreadsheet. There was no evidence to suggest that any use was made of this data other than to generate graphical representations. Having generated the graphs the children were deemed to have completed the activity; the activity did not include any focus on interpreting the graphs. The emphasis here seemed to have been on exposing the children to the software:

> Although the plans say database I decided to go for spreadsheets on popular Tudor personalities. The aim was familiarisation and confident use of the software - I don't think that they have ever done that before.
>
> (Mr Jones, 28th Mar)

> They had a sort of class vote so everyone had the same data which they considered to be their favourite person and it was suggested that they did a fairly basic sort of block graph and then if they had time they could mess about with the spreadsheet package.
>
> (Nursery Nurse, 3rd May)

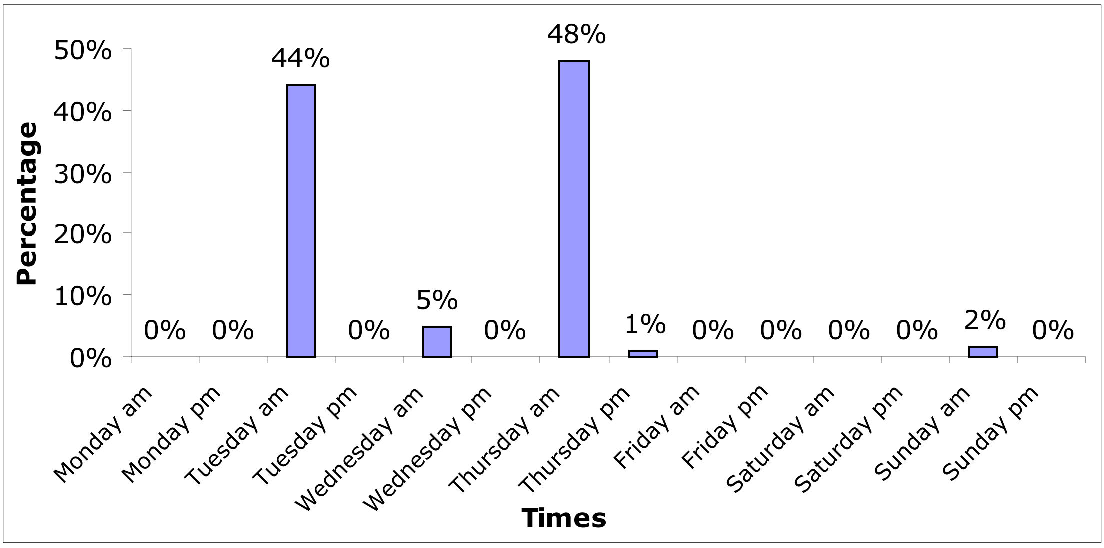
One of the most striking features of the computer use during this time was the extent to which the computer use was focused on familiarisation with the software:

Researcher	What do you think they learnt?
Nursery Nurse	Um what did they learn? Obviously how to switch on and shut down their computer, they had some idea about how to get about in the programs.

(Interview, 3rd May)

The other striking feature was the extent to which the class teacher seemed to avoid any involvement with the computers. All of the computer work took place in withdrawal groups that worked in the dining area outside the classroom. These were led by the nursery nurse who worked with the class on Tuesday and Thursday mornings. This was confirmed by the Automatic Logs which showed that the vast majority of the computer use during Period 4 took place on Tuesday and Thursday mornings (see Figure 3.18).

Figure 3.18 Distribution of computer use in 4JJ



Indeed it became very clear that Mr Jones had had virtually no involvement in any aspect of this work. The researcher's field notes, for example, indicated that Mr Jones took no part in the computer work on the 1st or 8th of March:

> Mr Jones said he did not know what they were doing because the nursery nurse was looking after them - "she is happy to take them out and do it with them. I do not know what they have done."
>
> (Field notes 1st Mar)

> Mr Jones commented to me that the children really liked working on the computers and got very excited about it. He then told Yellow group to go out to the nursery nurse who would show them what to do. He told the children to remember to take the pieces of paper with them that showed who the most popular Tudor / Stuart

> was. ….. During this session Mr Jones did not go out to see what the children on the computer were doing. He spent the entire session circulating within the classroom.
>
> (Field notes 8th Mar)

The low level of involvement of Mr Jones with the computers extended to planning for the activities. It appeared from the evidence collected that whilst Mr Jones set out the basic framework for what the children would do each week the nursery nurse sorted out the actual details of this. Thus, for example, in the second week when they used the computers Mr Jones had decided they would use the painting program but the nursery nurse decided that they would draw a picture of the Mary Rose with the aid of the worksheets:

> It was her [the nursery nurse's] idea to produce a simplified ship.
>
> (Mr Jones, 28th Mar)

The nursery nurse also appeared to be responsible for sorting out the way in which the children were organised when working on the computers:

> She [the nursery nurse] would tell me if a particular child had been a problem or if there had been heavy weather. She would have borne that in mind next time and might have changed the groupings. It was up to her really.
>
> (Mr Jones, 28th Mar)

Thus, whilst the children did use the computers, the class teacher played a minimal role in this. This fitted in well with the conflict that the researcher had noted at an early stage in the case study between Mr Jones's feelings about computers and the pressure he felt under to use them.

> Mr Jones — At least they weren't sitting in the cupboard. That would be a bit of a waste.
>
> (Field notes 1st Mar)

This low involvement of the teacher in the computer use, and its restriction primarily to two timeslots each week indicated that IT was not being used whenever it could enhance learning. Even when the computers were in use their full potential to enhance the children's learning was not being utilised. This was very clear in the case of the data handling activity where no attempt was made to interpret the graphical representations, yet alone to consider the most appropriate forms of representation to enable the children to analyse the data.

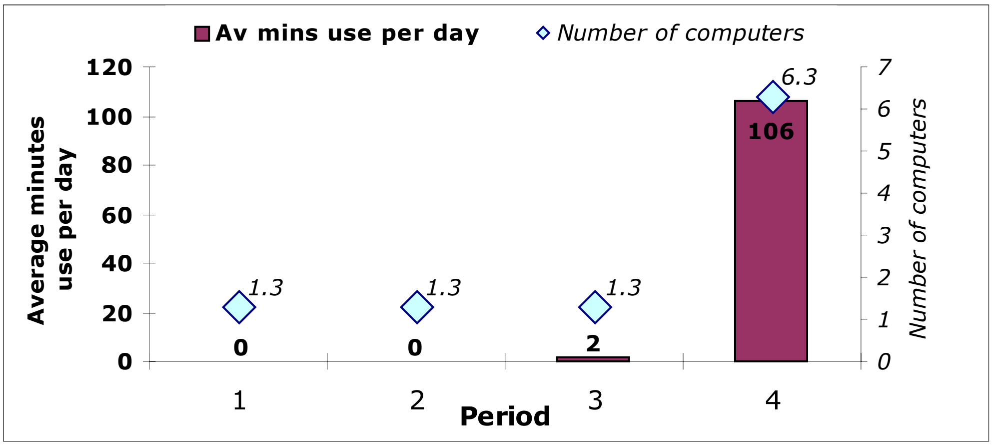
Table 3.13 Summary of quality of computer use in Period 4

Criteria	Summary rating
Planned	Yes
Involving teacher	No –significant involvement of nursery nurse
Integral (real purpose)	No – set in context of topic
IT or other subject focused	IT mainly
Distributed or IT slots	IT slots
Using full potential of IT	No
Overall	4 (Weak)

Analysis of the extent to which the data from 4JJ fitted the hypotheses

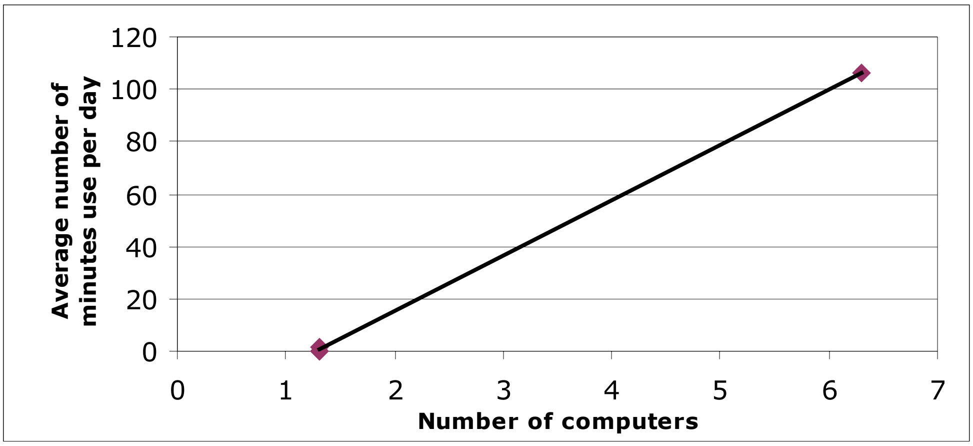
Figure 3.19 shows the quantity of computer use superimposed over the number of computers available in 4JJ during Periods 1 to 4. This suggested that when the five PowerBooks were added (Period 4) there was a substantial increase in the quantity of computer use.

Figure 3.19 Comparison of the number of computers and quantity of computer use during Periods 1 to 4 in 4JJ



This relationship between the number of computers and the quantity of computer use is even more clearly shown in Figure 3.20, which plots the quantity of use against the number of computers for Periods 1 to 4.

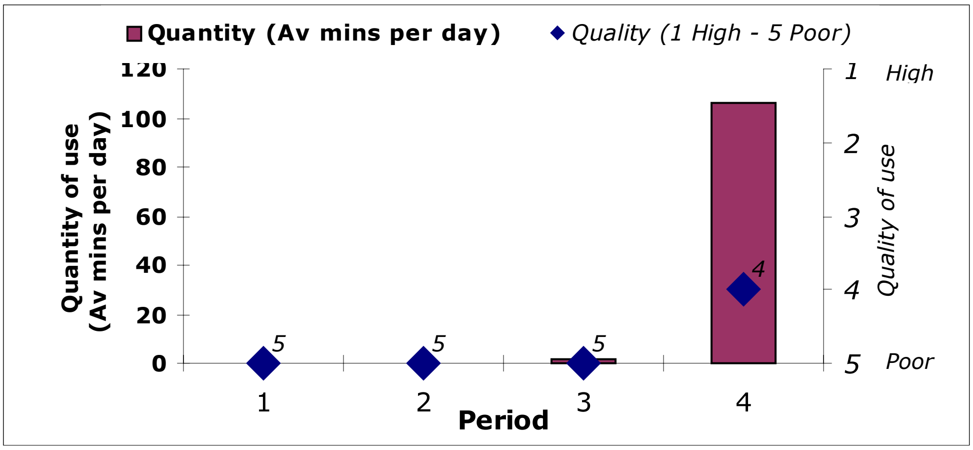
Figure 3.20 Relationship between the number of computers and the quantity of computer use in 4JJ



From this analysis it appeared that the quantity of computer use did increase with the addition of the five PowerBooks. However, looking at the distribution of computer use within Period 4 (Figure 3.13) showed that there was no computer use in the first week, which was the week before the half term holiday. The computers were then used each week for the first three weeks after half term. There was then no computer use in the final week of Period 4. Thus, the addition of the five PowerBooks did not lead to an immediate increase in the quantity of use. Other factors played an important part in determining whether or not the quantity of use increased.

Figure 3.21 plots the quantity and quality of computer use in 4JJ during each Period. This provided some support for the view that increases in the quantity of computer use were associated with increases in the quality of use.

Figure 3.21 Comparison of the quantity and quality of computer use in 4JJ during Periods 1 to 4



When the quantity of computer use was below 5 minutes per day the quality of computer use was poor (5). As the quantity of computer use increased above 100 minutes per day the quality also increased.

There was no evidence to suggest that increases in the quality of computer use were associated with further increases in the quantity of use. Indeed, towards the end of Period 4 the quantity of computer use fell, which suggested that there was no relationship in this case between the quality of computer use and the subsequent quantity of use.

Case Study 3

Description of the third Case Study classroom (2BH)

The Case Study 3 class (2BH) was a Year 2 class (6 to 7 year olds) with 25 children in it. The class teacher (Mrs Breda Humphries) had been teaching for approximately 18 years, 12 years of which had been at County School. She held the posts of responsibility for Technology, KS1 Science and Assessment within County School. In addition to the class teacher, 2BH had a nursery nurse on one morning per week.

Mrs Humphries stated that the class benefited from having lots of parental helpers on a regular basis (Mrs Humphries, 30th Nov). The class worked closely with the adjoining Year 1 class (referred to as 1JP):

> Wednesday morning is project morning when we combine with Y1s – we have lots of parent helpers. We focus on practical things.
>
> Mondays and Tuesdays tend to be individual class work (focus on English and Maths), whereas later in the week are more joint things [with Y1s]. I tend to do story writing or some sort of writing exercise on Monday mornings. We also have a time when we change classes to do formal English, well that's a Friday when I have some of 1JP and some of mine go to 1JP.
>
> (Mrs Humphries, 30th Nov)

During the case study 2BH had sole access to a BBC Master. Mrs Humphries also mentioned being able to borrow an A3000, but in order to do this she would have to transport it from the later years half of the school and in practice this was not feasible. Thus the baseline figure for computers for 2BH was 1.

At the start of the study Mrs Humphries reported that she was not confident about her own IT ability and that she held a neutral or slightly negative attitude to the use of computers in education (Questionnaire 30th Oct). However this was not reflected in the extent to which she reported using computers with her children:

> I use computers with my children weekly.
>
> (Questionnaire 30th Oct)

> I do use it [my computer] weekly, I use it more than weekly probably.
>
> (Mrs Humphries, 30th Nov)

It became clear during the initial interview that Mrs Humphries thought that computers were an important part of children's lives, which they needed to be able to master:

> Mrs Humphries No, No, No, No. I think for the future children have got to be able to use computers, I mean that's the way everything is going to work isn't it.
>
> (Mrs Humphries, 30th Nov)

She also clarified her negative attitude towards computers as being more to do with the practicalities of computer use in schools:

> And it, it's no go if you can't rely on it to work, so you're bound to have a bad attitude to it.
>
> (Mrs Humphries, 30th Nov)

> Mrs Humphries But I think that those children are perhaps only going to get five minutes in the week or ten minutes in the week, so to think that you can use it all the time and only that, you can't...
>
> Researcher Right.
>
> Mrs Humphries It's overrated in that way.
>
> ……
>
> No I think they have their place.
>
> Researcher Right.
>
> Mrs Humphries But sometimes, I don't know... They've definitely got a place there but I feel myself that I'm not using them as well as I might. And I'm a bit frightened of it anyway.
>
> (Interview, 30th Nov)

Analysis of the quantity of computer use in 2BH during Periods 1 to 6

Periods 1 to 5 covered the last half of the Autumn term, the whole of the Spring term and the first half of the Summer term. During this time 2BH had sole use of one BBC Master. There was no mention of IT in the schemes of work or the topic webs for 2BH during this time or in the weekly plans for Period 5. However there was extensive evidence from other sources that the computer was used on a frequent and regular basis throughout much of this time.

The ongoing activities planning sheets for Spring Term (periods 2 to 5) referred to the use of 'Starspell' (a spelling program on the BBC Master) as a follow up activity for their spelling work. This was confirmed by the teacher's Computer Notebook which indicated systematic use of 'useful little programs' (such as 'Starspell') over the whole of the period. The Manual Logs also indicated that the computer was used, though for varying amounts of time, over Periods 1 to 5 (see Table 3.14).

Table 3.14 Quantity of computer use by 2BH during Periods 1 to 5

Period	Total use (mins)	Average use (mins per day)
1	930	25
2	195	16
3	985	49
4	350	13
5	750	27

Period 6 covered seven weeks towards the end of the Summer term. During this time 2BH had access to their BBC Master plus the five PowerBooks. The computer logs for this period indicated a high level of use: the Manual Logs listed 8252 minutes of computer use of which 7817 minutes was on the laptops; the Automatic Log listed 8492 minutes use on the laptops.

There was extensive evidence to corroborate the level of use of the computers. This included Mrs Humphries' Computer Notebook, which indicated continued use of 'useful little programs' on the BBC. There was also extensive mention of computer use in Mrs Humphries' plans. Specific references to data handling and story writing were made in the 'cross curricular themes' planning sheet. Five out of six weekly planning sheets also clearly highlighted the use of the computers. The researcher's field notes supported the view that the laptops were used extensively in Period 6.

The quantity of computer use in Period 6 was estimated as being 8492 minutes on the laptops and 435 minutes on the BBC Master. This represented a total of 8927 minutes or an average of 263 minutes per day.

Analysis of the quality of computer use in 2BH during Periods 1 to 6

This analysis uses the 'quality criteria' specified on Page 73.

2BH used a number of programs during Periods 1 to 5, which are summarised in Table 3.15.

Table 3.15 Software used in 2BH during Periods 1 to 5

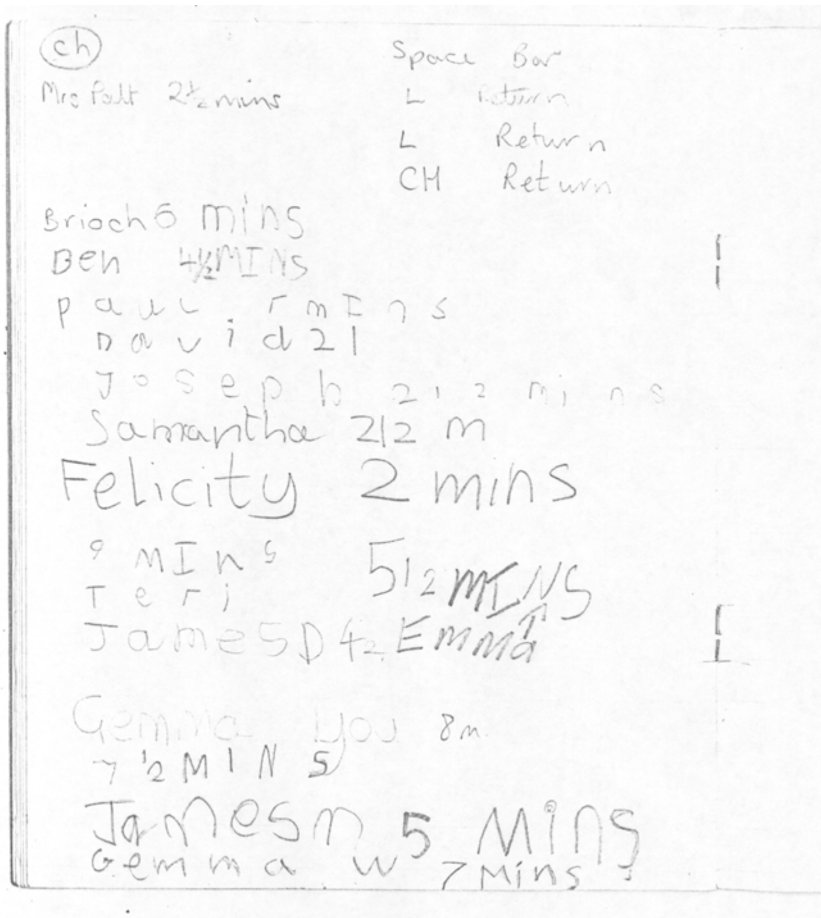
Software used		Period				
		1	2	3	4	5
Drill and Practice	Star Spell	✓		✓	✓	
	Light Pen			✓		✓
	Ambleside	✓				
Adventure games	Geordie Racer			✓	✓	
	Dragons Eye	✓	✓			
Content free	Compose					✓
	Ourfacts				✓	
	Stylus	✓		✓		✓

The way in which specific programs were used appeared to be consistent across the periods, based on the researcher's observations and informal discussion with Mrs Humphries. In addition, certain specific programs were used in very similar ways. For example, the three 'Drill and Practice' programs, Star Spell, the Light Pen and Ambleside, were all used in the same way. In order to avoid duplication the discussion of the quality of computer use in Periods 1 to 5 is dealt with in one block.

There was very little mention of IT in any of Mrs Humphries plans for the Spring Term (covering half of Period 2 and all of Period 3) or in the first half of the summer term (covering Period 4). The exceptions to this being specific mention of the use of Star Spell for 'follow up work' in her overview plan for spelling at the beginning of the year, and references to data handling and writing stories on a word processor in the IT plans for the Summer term.

The lack of mention of any computer use in any of the weekly plans for Periods 2 to 5 suggested that their use was not planned. However, Mrs Humphries had established the use of a Computer Notebook in which she would write simple instructions telling the children which program to use and how to load it (See Figure 3.22). This system was used for the Drill and Practice Software, the Adventure Games and Compose.

Figure 3.22 An example of a page from 2BH's Computer Notebook



The use of the Computer Notebook could be viewed as a form of planning, in that it did indicate that Mrs Humphries had thought about what software to use in advance. For the drill and practice software the level of planning required was very low. For example, in the case of Spell Star, it simply involved identifying the letter blend that they were working on that week. Similarly, the use of Through the Dragon's Eye linked in with their watching of the television programme so Mrs Humphries may not have felt the need to plan it separately. The absence of any mention of the use of Stylus (the word processing program) in either the Computer Notebook or the formal plans suggested that it was not planned.

Most of the use of computers in 2BH during Periods 1 to 5 was well integrated with other classroom work. For example, the extensive use that 2BH made of drill and practice software was closely integrated with their on-going language work in the classroom.

> Well I'm using it to reinforce something that I've done in the class, like it might be a spelling sound or re-enforcing if I know what I've got that I can do with maths, if the symptom fits into with my maths so it's working alongside what I'm doing in the classroom.
>
> (Mrs Humphries, 30th November)

The same was true for their use of Through the Dragons Eye, which tied in with their watching of the 'Look and Read' television programmes and the associated class work. Similarly, their use of Stylus (for word processing) was linked with the other activities in the class, in the sense that they were copy typing work that they had done in pencil which Mrs Humphries wanted to include in a display (e.g. Manual Logs 1st Dec, 8th Feb). The only computer use that had no clear link with other classroom activities during Periods 1 to 5 was the use of Compose. Indeed, Mrs Humphries indicated that she viewed this as something of a play activity:

Mrs Humphries	Well you always come out with something that sounds reasonably good, don't you. Yeh. But really that's just a case of the children having a fiddle with it.
Researcher	Right.
Mrs Humphries	And play with it and that's we don't do any more with it.

(Interview, 16th May)

In general Mrs Humphries' level of involvement with use of the different types of software consisted of initiating the activity and then taking no direct part in its transaction. For drill and practice software in particular (e.g. Spell Star) Mrs Humphries was keen that the children could operate without her direct intervention:

Mrs Humphries	I also want them to be able to set it up for themselves because they're not used to doing it themselves.
Researcher	Right.
Mrs Humphries	So by writing at the top what to do they can now go to it and actually find what they want to do or what I want them to do...
Researcher	Right.
Mrs Humphries	Without me having to be there every two minutes.
Researcher	So they actually, you tell them which sounds to do..
Mrs Humphries	Yes.
Researcher	And then they get to choose the appropriate disc...
Mrs Humphries	They'll do it,
Researcher	And load it all up.
Mrs Humphries	Yep.
Researcher	Did they know or is that something you've had to train them to do.
Mrs Humphries	Yes, that's something new to them this year. They're doing well with that, they can go and do that usually, well most of them can go and do it. And these things, they're so short they have to be able to set it back up themselves or I'd be there all the time and they can do that and get the next person to go.

(Interview 30th November)

A similar pattern was evident for the use of Compose and the Adventure Games. Indeed, Mrs Humphries identified that the extent to which children had access to some of the more demanding software reflected the degree to which they could use it without her intervention:

Mrs Humphries	So then it tends to be the brighter ones who do it, because I know that they are going to get something out of it, they can go off, they can do it, and enjoy it. Rather than the poorer ones are going to have to have me there every two minutes because of the reading that's involved on the IT.

(Mrs Humphries, 16th May)

Mrs Humphries also made use of parent helpers to work with children, particularly when they were word processing (e.g. Field Notes 2nd Feb; Manual Log 1st Dec).

The only occasions when Mrs Humphries worked intensively with children using the computer was when she was demonstrating a new program to the whole class. This happened when she introducing them to Through the Dragon's Eye:

Mrs Humphries	So it's Through The Dragon's Eye. But that takes a long time and to start that off we all had to do it together. We sat down and we did a computer session. So we sat...
Researcher	What you with the whole class.
Mrs Humphries	Um hum.
…	
Mrs Humphries	And then they went away and did it, themselves or had a go at it. But that took an awful long time to get it through all the children. But was good.

(Interview 16th May)

The main aims for the vast majority of the computer use in Periods 1 to 5 appeared to be on using the computer to support the children's learning in other subjects. This was clearly the case for the drill and practice software, which because of its simplicity offered little opportunity for learning about IT. The use of the drill and practice programs was all directed at the reinforcement of specific basic skills (e.g. letter formation in the case of Light Pen) or knowledge (e.g. number bonds in the case of Ambleside). Similarly, the use of the Adventure Games was focused on reinforcing work that the children had been doing in the class.

On the basis of the Manual Logs and Field Notes it appeared that most of the use of Stylus during Periods 1 to 5 involved the children in copy typing or in some cases a parent keying in work for the child. This was confirmed by Mrs Humphries who reported that they had not managed to find the time to go beyond this (Mrs Humphries, 16th May). This was despite the fact that she seemed to aspire to use the word processor as a tool to enhance the children's writing, by allowing them to write directly on it rather than copy typing:

Mrs Humphries	So Um, also for writing the children sometimes use the computer to write on, use it as a word processor.
Researcher	Right.
Mrs Humphries	Not just copying, but doing their first draft on the computer and then having a go at changing it.
…	
Researcher	Right. But if you were doing, I mean have you done it this year.
Mrs Humphries	No I haven't done it at all. I mean they've used it in that they've been writing something neat to go on the wall.
Researcher	Right.
Mrs Humphries	And it's been a short thing and I've given them about half an hour to do it

(Interview 16th May)

On the basis of the Manual Logs it did appear that computer use by 2BH was fairly evenly spread throughout the week during Periods 1 to 5 (Table 3.16). There was some variation across the periods, for example there was less computer use in Period 4 and this was concentrated on certain days. However this variation was largely due to the timing of the end of Key Stage 1 Standard Assessment Tests which took place during Period 4. As such Period 4 was atypical.

Table 3.16 Distribution of computer use by 2BH during Periods 1 to 5

%	am	pm	Day total
Monday	11	14	25
Tuesday	11	9	21
Wednesday	10	12	21
Thursday	9	10	18
Friday	12	4	16
am/pm Total	52	48	100

This even distribution of the use of computers, combined with the way in which IT use was integrated with other work suggested that Mrs Humphries was using IT whenever it could enhance learning. However, the fact that the average quantity of computer use was around 30 minutes per day across Periods 1 to 5 indicated that there was scope, at least in theory, for much greater use to have been made of the computer to enhance the children's learning.

Most of the use of the computers appeared to be educationally driven in the sense of supporting educational objectives. The possible exceptions to this being the use of Compose and copy typing using Stylus. However, using computers to reinforce basic skills does not take full advantage of their potential to enhance learning, nor does copy typing. Thus 2BH were not making full use of the potential of the technology to enhance their learning.

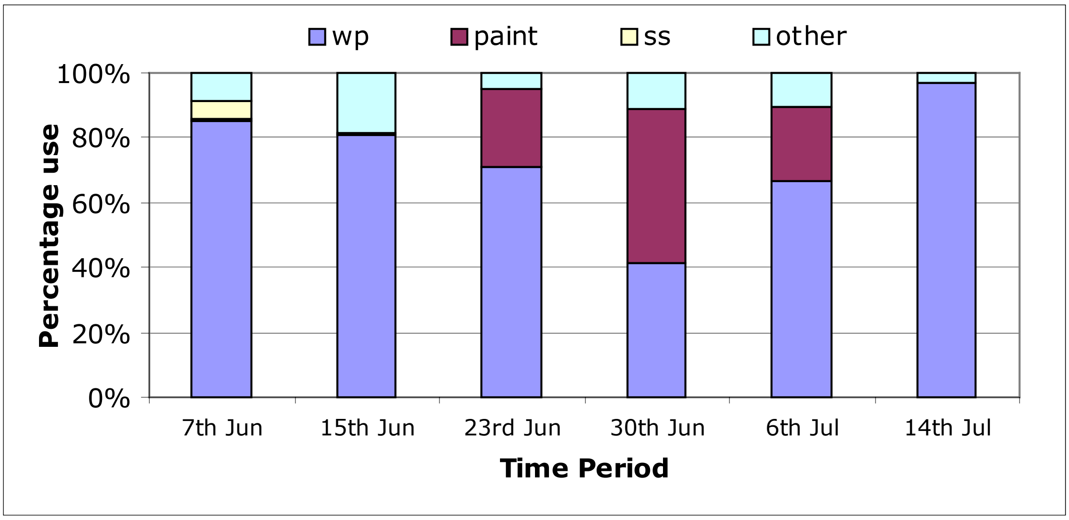
Table 3.17 Summary of quality of computer use in Periods 1-5

Criteria	Summary rating
Planned	Partially – Computer Notebook, except for word processing
Involving teacher	No – except to introduce activities
Integral (real purpose)	Reinforcement of basic skills
IT or other subject focused	Other subject focused mainly
Distributed or IT slots	Distributed – but limited to English & Maths
Using full potential of IT	No
Overall	4 (Weak)

During Period 6 there was a marked decline in the quantity of use of the BBC, which was accompanied by a shift in its use from drill and skill to word processing, with Spell Star and Stylus being the only two programs used. During Period 6 the use of drill and skill accounted for less than 2% of all the computer use. As such it did not impact significantly on the overall quality of computer use during this time. Stylus, whilst still only accounting for a small percentage of the total computer use during Period 6, was used in much the same way as the word processing software on the laptops. Thus, the quality of computer use during Period 6 was judged on the basis of the quality of the use of software on the laptops.

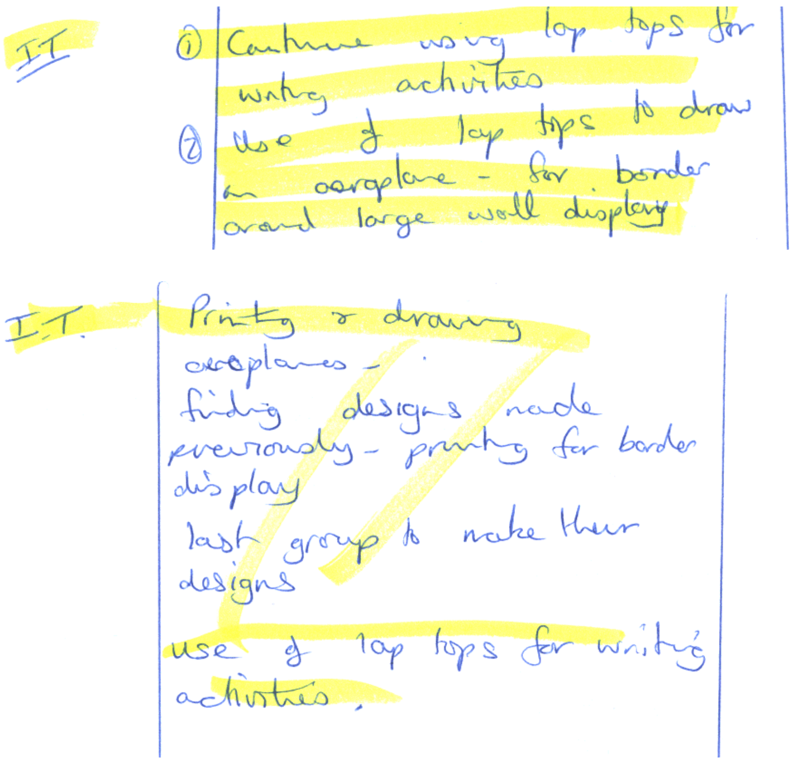
The Automatic Logs indicated that 2BH initially focused on using the word processor throughout Period 6, with a significant amount of use of the painting package during the middle of this timeframe (see Figure 3.23). This pattern of usage was confirmed by the Manual Logs, field notes and Mrs Humphries' weekly plans.

Figure 3.23 Percentage use of each application in Period 6, based on the Automatic Logs



In contrast with the computer use in Periods 1 to 5, explicit mention was made of the computer use in each of Mrs Humphries' weekly plans for Period 6, as illustrated by the extracts in Figures 3.24 and 3.25.

Figure 3.24 Illustrative extracts from Mrs Humphries' weekly plans for Period 6


IT
① Continue using lap tops for writing activities
② Use of lap tops to draw an aeroplane - for border around large wall display

I.T.
Printing & drawing aeroplanes -
finding designs made previously - printing for border display
last group to make their designs
use of lap tops for writing activities.

Figure 3.25 Extracts from the Weekly planning sheet 23rd-27th May

WEEKLY PLANNING SHEET May 23rd - 27th

	ACTIVITIES	INTENDED OUTCOMES
English	① Drama gp - working with children in a workshop and a production for each other - relating to Electricity	En 1 Speaking & Listening Level 1, 2 & 3
	② Writing - after all our work on people who work around school. Children will be asked to write about what they would like work as when they grow up & why.	En 3 Level 2 + 3 non chronological writing - report with reasons.
	③ Word Banks - resumed after SATs period	
	④ Language - shortening 2 words into one using an apostrophe - several children trying to do this in their free writing at the moment	
	⑤ Letter writing to each other - postman follow up.	
IT	Lap top computers moved into Class 3 this week. ① To begin gps of children given the opportunity to produce their writing about their jobs on the lap tops (1st groups 1st draft straight onto computer Later groups as a 2nd draft) This grouping to be reversed next time ② Try to use spelling bank in 1st drafts.	IT Level 1 work with a computer Level 2 + 3 use information technology to make amend & present information

The Manual Logs indicated that with the exception of the database work, which did not take place, the use of computers in 2BH did follow the pattern described in the Weekly plans.

The details in the weekly plans suggested that the use of the laptops was closely integrated with the other work in the classroom. This was illustrated, for example, by the cross-referencing of the English and IT sections of the weekly plans for the first week of Period 6 (Figure 3.25).

Further evidence for this came from the level of involvement that Mrs Humphries took in the computer activities. In contrast with the computer use in Periods 1 to 5, where she very seldom interacted with children when they were using the BBC, Mrs Humphries often worked with the children who were using the computers in Period 6 (e.g. Field Notes 7th June, 15th June). This interaction took two different forms. Firstly, the introduction of new equipment and software (i.e. word processor and painting program) involved her doing a demonstration to the whole class, in much the same way as had happened with Through the Dragons Eye. Secondly, she circulated between the groups of children, some of whom were using the computers and others who were not. When she was working with individual children who were using the computers the main focus of her interactions was related to technical issues, such as how to operate the software or how to print out. This higher level of involvement by Mrs Humphries was despite the fact that children from 5DS occasionally came to 2BH to help show the children how to use the software (Manual Logs; Field Notes 7th June).

The need for Mrs Humphries to spend so much time supporting the children as they used the computers, particularly in the initial stages, highlighted the fact that most of the focus of the activities whenever a new application was introduced was on learning how to use it. This was true even when the children were writing straight onto the computers, where one might have expected the focus to have been on the content of their writing. This view was supported by examination of samples of work from this time. For example, Figure 3.26 shows the word processing that Ricky did on the 7th June. He composed straight onto the screen, but there is little evidence of the teacher having focused his attention on editing or enhancing his text, or even finishing it. This suggested that Mrs Humphries' focus was on teaching the children to use the software rather than on developing their writing skills.

Figure 3.26 Example of a Ricky's writing straight on to the computer

> on my holiday I went to Donnas party . I had a very nice time. but their was just one problem. and that problem wasnt a very bi

The word processing software was used in two different ways during Period 6. Children either started writing directly on it, which Mrs Humphries called 'doing a 1st draft' or they copy typed work that they had previously done on paper, which she called 'doing a 2nd draft' (Field Notes 7th & 15th June). Less than half the sessions recorded were copy typing; '2nd drafts' accounted for 43% of the word processing entries in the Manual Logs.

The decision about whether a child should write straight onto the screen or copy type was based on pragmatic considerations (Mrs Humphries, 30th June). For example, if the children had already done their main writing task for that week on paper when it was their turn to use the computer then they would copy type it, other wise they would write it straight onto the machine. The Manual Logs provided some evidence to confirm that this was what happened; for example, on the Monday of the first week of Period 6 those children who used a computer before morning play wrote straight onto the machines, whilst those who used them after morning play copy typed.

Despite the fact that the Manual Logs referred to 1st drafts and 2nd drafts, the vast majority of the work on the computers was limited to one session on the computer. Thus, even where the Manual Logs indicated that the same child used the same computer to do a 1st draft and a 2nd draft the samples collected showed that these were unrelated pieces of work (see Figures 3.26 and 3.27 for example). In effect the children either wrote directly onto the computer, making minimal changes to their text as they wrote (e.g. using the backspace key to delete the last letter or word) or they copy typed work that they had already done by hand and which had often already been corrected by Mrs Humphries (Field Notes 30th June). There were some exceptions to this, particularly in the last week of Period 6 when ten children each spent two sessions word processing their letters.

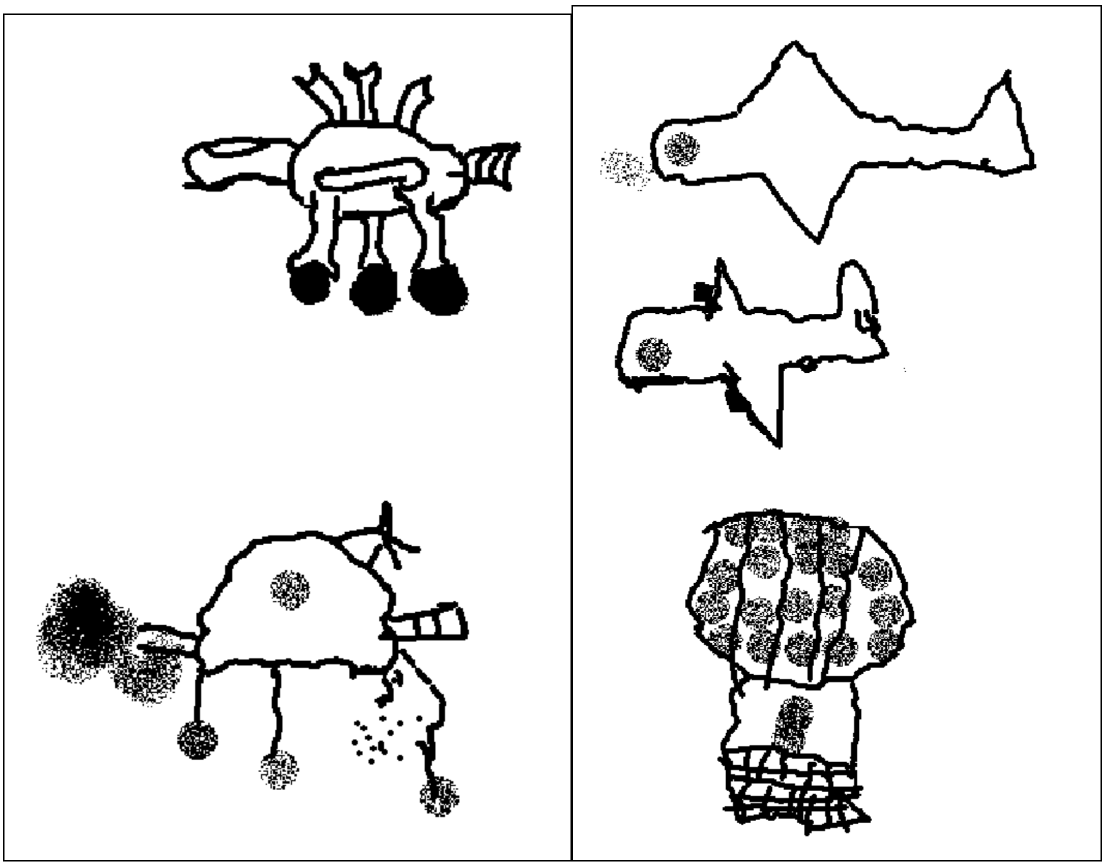
Perhaps not surprisingly, the quality of the samples of work that were copy typed were of a higher standard than the work that was written directly onto the computer. For example, comparing text produced by Ricky when word processing (Figure 3.26) with work he copy typed (Figure 3.27) showed that the latter work was much more sophisticated. His copy typed work was not only longer, but also used more complex sentence structures and vocabulary, and included more accurate use of full stops.

Figure 3.27 Example of Ricky's copy typing on the computer

> Ricky when I grow up I want to be an aurther and a rock climber. to be a rock climer i will need a lot of determanasion and skill. to be an aurther I will need a lot of finger power.I want to be these things beckos I am strong brave and I have lots of agility.

When the children were using the painting program they composed straight onto the screen. As with the word processing, their initial focus was on learning how to use the software. However, on a large proportion of the occasions when the painting software was being used the children worked in pairs, with each pair consisting of one child from 2BH and one from the adjacent Year 3 class (Manual Logs). Mrs Humphries commented that this made it easier for her as the Year 3 children helped to show her's what to do (Field Notes 30th June). Many of the finished pictures were quite sophisticated for children of this age (see Figure 3.28). For example, the picture in the top left of Figure 3.28 has features that correspond to Luquet's Visual Realism stage, which children normally reach between the ages of 8 and 12 (Krampen 1991). It therefore seemed likely that their focus, at least after the initial introduction to the painting program, was on creating their pictures, using the facilities provided by the software (e.g. the Undo option). Thus they were engaged in learning about Art & Design as well as IT.

Figure 3.28 Example of paintings produced by children in 2BH working with children from the adjoining Year 3 class



Interestingly, the distribution of computer work in 2BH in Period 6 was quite different to that in the Previous Periods (compare Tables 3.16 and 3.18). The vast majority of computer use took place in the mornings in Period 6 (72% compared with 52% in Periods 1 to 5), and there was very little use on Wednesdays or Fridays (5% and 7% respectively compared with 21% and 16%). Mrs Humphries also spent time familiarising herself with the laptops at the weekends (1% on both Saturdays and Sundays).

Table 3.18 Distribution of computer use by 2BH during Period 6

%	am	pm	Day total
Monday	34	10	43
Tuesday	15	2	18
Wednesday	2	3	5
Thursday	16	10	25
Friday	6	1	7
Saturday	0	1	1
Sunday	0	1	1
am/pm Total	72	28	100

This apparent restriction of the computer use to fewer sessions throughout the week might be seen as indicating that they were not being used whenever they had the potential to enhance learning. Interestingly however, they were being used to support work in English (writing), Science (writing factual reports) and Art ('painting' aeroplanes) as well as to develop the children's IT. This was a wider range of subjects than was being supported in Periods 1 to 5, despite the fact that a much smaller range of software was being used in Period 6.

The distribution of computer use in Period 6 did suggest that there was scope to make fuller use of the computers. Furthermore, even where the computers were being used they were often not being used in ways that made full use of their potential to enhance learning. This particularly seemed to have been the case for most of the word processing work, where children were either copy typing or did not have sufficient time to take advantage of the opportunities the software offered for re-drafting and formatting their text.

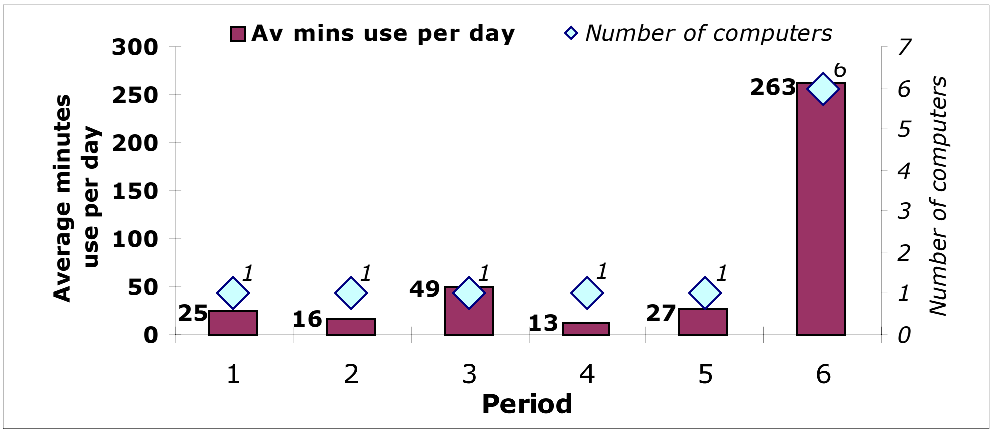
Table 3.19 Summary of quality of computer use in Periods 1-6

Criteria	Summary rating
Planned	Yes
Involving teacher	Yes
Integral (real purpose)	Yes
IT or other subject focused	IT initially, increasing focus on other subjects
Distributed or IT slots	Restricted primarily to mornings – use in English, Science and Art/Design
Using full potential of IT	No
Overall	3 (Moderate)

Analysis of the extent to which the data from 2BH fitted the hypotheses

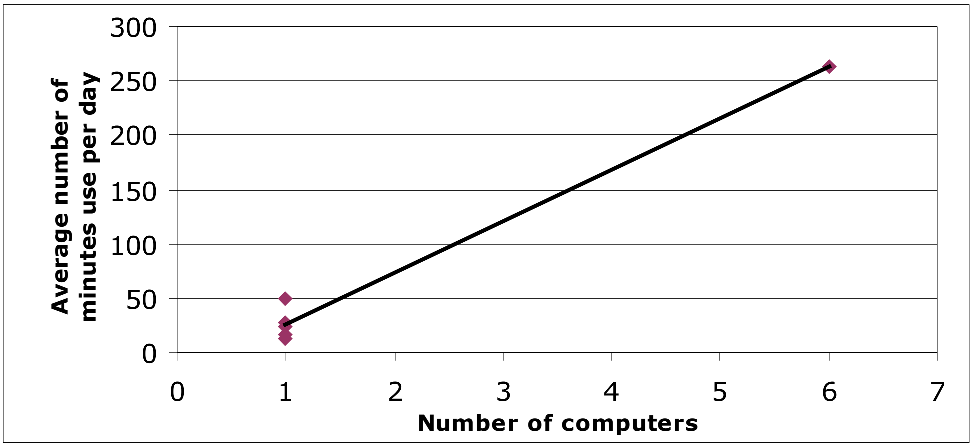
Figure 3.29 shows the quantity of computer use against the number of computers available in 2BH during Periods 1 to 6. This suggested that when the five PowerBooks were added (Period 6) there was a substantial increase in the quantity of computer use.

Figure 3.29 Comparison of the number of computers and quantity of computer use during Periods 1 to 6 in 2BH



This relationship between the number of computers and the quantity of computer use is even more clearly shown in Figure 3.30, which plots the quantity of use against the number of computers for Periods 1 to 6.

Figure 3.30 Relationship between the number of computers and the quantity of computer use in 2BH



From this analysis it appeared that the quantity of computer use did increase with the addition of the five PowerBooks. However, Figure 3.31 shows that the quantity of computer use fluctuated throughout Period 6. There was an initial burst of activity when the computers were added, which fell sharply after a couple of weeks. This suggested that other factors played an important part in the quantity of computer use.

Figure 3.31 Average quantity of computer use per day by 2BH throughout Period 6

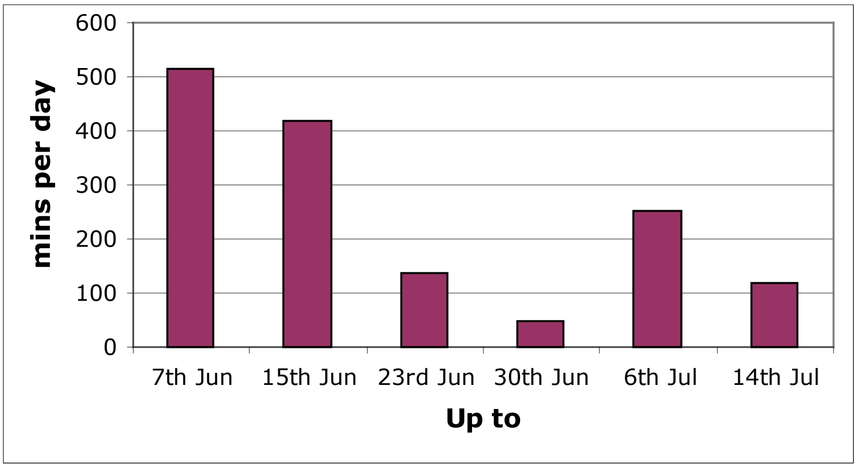
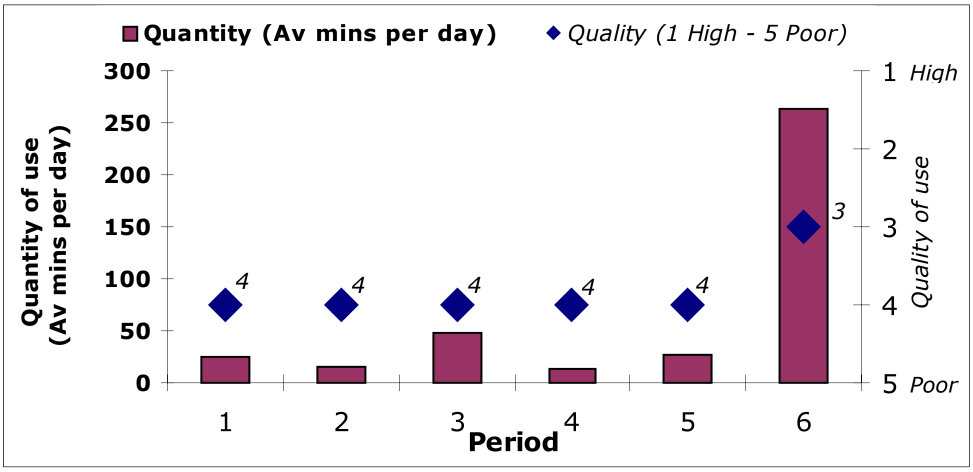


Figure 3.32 plots the quantity and quality of computer use in 2BH during periods 1 to 6. This analysis provided some support for the view that increases in the quantity of computer use were associated with increases in the quality of use.

Figure 3.32 Comparison of the quantity and quality of computer use in 2BH during Periods 1 to 6



When the quantity of computer use was below about 60 minutes per day the quality of use was less than 3. As the quantity of computer use increased to above 250 minutes per day the quality of use also increased.

There was no evidence to suggest that increases in the quality of computer use were associated with further increases in the quantity of use. Indeed, after the first couple of weeks of Period 6 the quantity of computer use fell (see Figure 3.31), which suggested that increases in the quality of use did not lead to further increases in the quantity of use.

Discussion of the hypotheses in the light of case studies 1 to 3

The analyses of the three case studies all showed that the quantity of computer use did increase with the addition of the PowerBooks. However, in both 5DS and 4JJ there were times during the Period(s) when each class had access to the extra equipment that they did not use it. In 2BH the quantity of use during Period 6, when they had access to the five PowerBooks, fluctuated between an average of over 500 minutes per day and less than 60 minutes use per day. Thus, in each of the case studies, whilst there was some connection between the addition of the PowerBooks and the quantity of computer use this was not a simple causal relationship; other factors impacted on the quantity of use above and beyond the quantity and quality of the resources available.

In all three of the case study classrooms the quality of computer use did increase when the quantity of use increased. The data suggested that there was a minimum threshold of use that needed to be exceeded before the quality of use was affected. However, there was not a straightforward connection between the quantity and quality of use. The analysis of the data from 5DS indicated that the amount of prior use the children had had of computers was also an important factor.

Perhaps more significantly, in each of the case studies the analysis of the quality of computer use raised issues about the criteria for judging quality. Thus, in Case Study 1 (5DS) the quality of the children's work appeared to be higher in Period 5 when they were carrying out activities that the class teacher had not planned. The level of planning by the teacher was not necessarily a good indicator of the quality of computer use.

In Case Study 2 (4JJ) during Period 4 the teacher played little, if any, role in the computer use, other than directing the children to leave the classroom in order to work with the nursery nurse. According to the quality criteria this should have indicated that the work would have been of low quality, which did not appear to have been the case. Thus, for example, the paintings of the Mary Rose were impressive, given that the children had not used the painting program before and only spent about an hour on this activity.

Case Study 3 (2BH) highlighted a conflict between the implicit value judgements about what constituted high quality work within the criteria. It was clear that the use of Drill and Skill software within 2BH prior to Period 6 was closely matched to the language and maths work that the children were doing within the class and that it had explicit educational objectives. However, the quality criteria placed a greater emphasis on the use of 'generic software' that could be used to enhance children's higher order skills than on the use of software to reinforce basic skills or knowledge, resulting in the quality rating for Periods 1 to 5 being lower than the quality rating for Period 6. This was despite the evidence that suggested that the computer was used very effectively to enhance children's learning during Periods 1 to 5, given the objectives that the teacher had set. There were certainly times during Period 6 when the only discernible impact of the computer use on the children's learning was on their IT skills and other times when even this was questionable. The quality criteria were value laden, in the sense of imposing judgements about the most appropriate ways to use the technology. This favoured the use of certain types of software even where that software was not being used in a way that would enhance children's learning. This was clearly problematic.

None of the three case studies provided any evidence to support the view that increases in the quality of computer use were associated with further increases in the quantity of use. In

Case Study 1 it did appear that the teacher was very keen to build on the positive learning experiences the children had had with the laptops and to harness their evident motivation. The fact that this did not appear to happen within the time span of the Case Study could be evidence that this timespan was too short. In Case Study 3 the quantity of use actually decreased during Period 6, again suggesting that there was no relationship between an improvement in quality of use and subsequent quantity of use. An alternative explanation, which had relevance for any relationship between the addition of the PowerBooks and the quantity of use, was that the initial increase in the quantity of use was due to the novelty of having the laptops.

The only conclusion that it was possible to draw about the original proposition was that it was, at best, too simplistic. Thus, further work was needed to explore and enrich the model. However, it was also clear from the analyses of these case studies that there were fundamental problems with the quality criteria that were used. These problems took two forms, related to the underlying value judgements implicit within the criteria relating to what effective computer use should look like and internal contradictions between the criteria. It was evident from this that better ways of describing and comparing computer use were needed, as a precursor to further exploration of the factors impacting on computer use. As noted in Chapter 2 this represented a change in the specific focus of the research, whilst the overall aim of finding ways of enhancing the impact of investments in ICT in education remained. Ways of describing computer use are explored in more detail in the next chapter, which represents the start of the first action cycle identified in Table 2.8 (p.61).

Chapter 4
Exploring descriptions of computer use

Introduction

In the previous chapter a proposition about one way of increasing the impact of investments in ICT in education was investigated. The conclusion reached was that before the factors that support and/or hinder computer use in education could be identified better ways of describing and comparing computer use needed to be found.

An examination of the educational computer innovation literature seems to support this view both when the focus is on learning to use computers and when it is on using computers as a tool to support learning. Twining (1995) and Schrag (1999) argue that there is a lack of precision in the literature, whilst a number of authors (e.g. Galton, Hargreaves and Comber 1998; Harris 1999) highlight a shortage of clear definitions within the literature, which they claim leads to inconsistency. For example, Selwyn (1997) states that "most studies have relied on vague and imprecise definitions of what actually constitutes being able to use a computer" (p.47). Twining (2002b) emphasises this point and provides examples of differences in the definitions that can be found in the literature. These

> vary from 'talking about computer related topics' without ever touching a computer (Anderson et al. 1979), through to using computers as an integral part of the curriculum to support teachers' learning objectives (Blease and Cohen 1990)
> (Twining 2002b p.97)

Similarly, CET (1975) found that "the literature is full of many different terms none of which are used consistently" (p.13). Alvarex and Kilbourn (2002) argue that the use of different labels by different authors to describe the same or similar phenomena is one of three reasons for the fragmentation of the literature in the field of the Information Society. The problem is further compounded in relation to the literature on computer use in schools by the fact that many studies do not provide any definitions of the terms they use.

Even where definitions are provided some studies are internally inconsistent, using a confusing range of different indices within the one study. For example, BECTa (2001b) in their report on the correlations between the quality of ICT resources in primary schools and pupils' attainment selectively use at least two different measures of attainment at KS2: the percentage of pupils getting Level 4 or above; and the percentage of pupils attaining 'above the national standards'. This selective use of a range of different measures leads to confusion and makes comparisons of the different correlations very difficult.

The problems resulting from a lack of definitions and consistency in the use of terminology are particularly significant in "a field in which research assumptions are contestable and results open to widely varying interpretations" (Hammond 1994 p.259). These problems are further accentuated by the differences in perspectives of people working in this field. This is one of the problems that occurred with the quality criteria in the previous chapter. The criteria implicitly assumed a particular stance towards the use of computers, which left them open to criticism by people who did not share that stance.

The cumulative effects of all of these problems have resulted in what Berman (1981 p.254) describes as "this noncumulative hodge-podge" of research findings. However, they also indicate one approach to enhancing the impact of ICT on education. Having clear and consistent ways of describing computer use across contexts is a precursor to identifying the factors that support and/or hinder the use of computers to enhance learning.

Hall and Hord (1987) highlight the need for all parties in a change process to have shared understandings. Using ICT in schools involves change, and researchers, policy makers and implementers of ICT in schools need to have shared understandings of what they are trying to achieve, shared definitions of terminology, and shared ways of describing the use of ICT in education and the impact that it is having. Thus, developing clear and consistent ways of thinking about and describing computer use would also directly support changes involving computers in education.

The focus of this research therefore moved away from developing a model of the factors impacting on the effective use of computers in education and towards an examination of ways of describing and comparing computer use in education.

Exploring existing frameworks

There are many frameworks relating to computer use in education. Some of these focus on specific components of computer use, for example Wegerif and Mercer's (1997) framework for researching peer talk, whilst others attempt to look at a more holistic picture. This latter group of 'holistic frameworks' are the most relevant to this study.

The fact that these frameworks have not been used widely in the literature suggests that there must be problems with them that inhibit their use. The aim of this chapter is to examine these existing frameworks, in the light of the three case studies, in order to identify any problems with them which may account for their under-utilisation. This analysis will be used to inform the development of a set of criteria for the design and evaluation of future frameworks. In the subsequent chapters these criteria will then be used to guide the development of a new framework. This process should lead to this new framework overcoming the problems identified in existing frameworks and thus becoming more widely used than previous frameworks. This in turn should provide a good starting point for further exploration of the lack of impact of the investment in educational computing previously identified in Chapter 2.

Squires and McDougall (1994) made a clear distinction between two types of frameworks for evaluating software, which could be labelled Software frameworks and Pedagogical frameworks. To these can be added another category of frameworks: Evolutionary frameworks. Each of these groups of frameworks is described below and specific examples are applied to the data from the three case studies in order to explore their strengths and weaknesses.

Software frameworks

Software frameworks are characterised by an explicit focus on the software *per se*; the software itself is used to define the dimensions of the framework. Squires and McDougal (1994) distinguished between four sub-categories of software frameworks. The first group of software frameworks, which were based on application type, were particularly prevalent in the early days of educational computing. The core dimension that they used was the 'type' of software, as illustrated by Wellington's (1985) framework in Table 4.1.

Table 4.1 Wellington's (1985) 'Application Type' framework

Category	Types of software
Teaching programs	Drill and practice; tutorial; electronic teaching aid
Learning programs	Educational games; adventure games; simulations
Tools	Information retrieval; word processing
Open-ended software	Logo

The second group of software frameworks focussed on the role that the software was intended to play as the key dimension. The classic example of this group of software frameworks is Taylor's (1980) classification, which is illustrated in Table 4.2.

Table 4.2 Taylor's (1980) 'Educational Role' framework

Category	Definition
Tutor	"The computer presents some subject material, the student responds, the computer evaluates the response, and, from the results of the evaluation, determines what to present next." (Taylor 1980 p.3)
Tool	The computer has some functionality that saves the learner time and allows her to focus her intellectual energy on higher order tasks.
Tutee	The computer is 'taught' something by being programmed by the learner.

The third group of frameworks used the educational rationale underpinning the software as the key dimension. Kemmis, Atkin and Wright's (1977) Instructional, Revelatory, Conjectural and Emancipatory 'paradigms' is the classic example of this group of frameworks (see Table 4.3).

Table 4.3 Summary of the 'Educational Paradigms for CAL' (based on Kemmis *et al.* 1977 pp.25-29)

	Instructional	Revelatory	Conjectural
Key concept	Mastery of content	Discovery, intuition, getting a 'feel' for ideas in the field, etc.	Articulation and manipulation of ideas and hypothesis-testing
Relevant theory / theorists	Skinnerian theory	Bruner (the spiral curriculum) and perhaps Ausubel (subsumption theory)	Piaget, Popper, Papert
Curriculum emphasis	Subject matter as the object of learning	The student as the subject of education	Understanding, 'active' knowledge
Educational means	Rationalisation of instruction, especially in terms of sequencing, presentation and feedback reinforcement	Provision of opportunities for discovery and vicarious experience	Manipulation of student inputs, finding metaphors and model building
Role of the computer	Presentation of content, task prescription, student motivation through fast feedback	Simulation or information-handling	Manipulable space/field/'scratch pad'/language, for creating or articulating models, programs, plans or conceptual structures
Assumptions	Conventional body of subject matter with articulated structure; articulated hierarchy of tasks, behaviouristic learning theory	(Hidden) model of significant concepts and knowledge structure; theory of learning by discovery	Problem-oriented theory of knowledge, general cognitive theory
Idealisation / Caricature	At best, the computer is seen as a patient tutor; at worst it is seen as a page turner	At best, the computer is seen as creating a rich learning environment at worst it makes a 'black box' of the significant learnings	At best, the computer is seen as a tool or educational medium (in the sense of milieu, not 'communications medium'); at worst, as an expensive toy
Software 'types'	Drill-and-practice	Simulation and some kinds of data-handling programs	Modelling, Artificial Intelligence packages and computer science applications
Emancipatory 'paradigm'	**Key concept**: the notion of reducing the inauthenticity of student labour. **Curriculum emphasis and Educational means**: derived from the primary paradigm with which it is associated - for it never appears in isolation except as 'an impulse to curriculum reform'. **Role of the computer**: calculation, graph-plotting, tabulation or other information handling		

The fourth group of software frameworks builds upon the three previous. Thus, they use two or more dimensions relating to software type, educational role and/or educational rationale. Chandler's (1984) Locus of Control framework is a good example of this, which uses the software type and the role that the user is expected to fulfil (see Figure 4.1).

Figure 4.1: Categories within Chandler's Locus of Control framework

Locus of Control

'Program' ———————————————— **'User'**

Tutorial	Games	Simulation games	Experimental simulation	Content-free tools	Programming languages
Programmed instruction, drill and practice	Computer as player or referee	Computer as game-world eg Empire style game & adventure genre	Mathematic-ally based models of processes such as scientific experiments	Word processors, sound and graphics manipulators, databases, scientific instruments, control technology	Logo Basic Smalltalk
Hospital model: user as patient	Funfair model: user as emulator	Drama model: user as roleplayer	Laboratory model: user as tester	Resource Centre model: user as artist or researcher	Workshop model: user as inventor

All of the software frameworks described above have an intuitive feel to them – their categories seem to make sense and help distinguish between differences associated with using different applications. However, applying them to the three case studies reveals a number of significant weaknesses.

Table 4.4 shows how a number of different uses of computers, which were described in one or more of the three case studies, would be categorized within the examples provided above for each of the four types of software frameworks.

Table 4.4 Categorisation of the computer use in 2BH

Framework type	**Application type**	**Educational role**	**Educational rationale**	**Composite framework**
Exemplar	**Wellington (1985)**	**Taylor (1980)**	**Kemmis *et al.* (1977)**	**Chandler (1984)**
Adventure programs	Learning programs	Unclear	Revelatory	Simulation Games
Ambleside Number bonds practice	Teaching programs	Tutor	Instructional	Tutorial
Drawing	Tools	Tool	Emancipatory & Unclear	Content-free tools
Light Pen Letter formation practice	Teaching programs	Tutor	Instructional	Tutorial
Spell Star Spelling practice	Teaching programs	Tutor	Instructional	Tutorial
Spreadsheet	Tools	Tool	Emancipatory & Revelatory(?)	Content-free tools
Trains Number pattern investigation	Teaching programs	Tutor	Instructional	Tutorial
Word processor	Tools	Tool	Emancipatory & Unclear	Content-free tools
Compose Music composition	Tools	Tool	Emancipatory & Unclear	Content-free tools

The first problem that is clear from looking at the analysis in Table 4.4 is that some of the frameworks are not adequate in the sense that they do not cater for all possible applications. Thus, for example, Mrs Humphries (16th May) talked about using an adventure program but this type of software does not fit easily into any of Taylor's categories.

A second, related problem occurs in connection with spreadsheets, word processors and drawing applications when using Kemmis *et al*.'s framework: whilst it is clear that these three applications all fall within the Emancipatory paradigm it is unclear which of the other three paradigms these programs fit within. This ambiguity is due to a lack of clarity in the definition of each of the paradigms. For example 'some kinds of data-handling programs' fit within the Revelatory paradigm, but it is unclear which kinds of data-handling programs. Furthermore, some aspects of the definition of the Conjectural paradigm fit with both word processing and spreadsheets (e.g. 'Manipulation of student inputs'), whilst other aspects of the definition of the Conjectural paradigm clearly do not (e.g. 'At best, the computer is seen as a tool or educational medium (in the sense of milieu, not 'communications medium'); at worst, as an expensive toy'). Thus ambiguity is created within Kemmis *et al*.'s framework from lack of specificity in the definitions and by apparent contradictions between different parts of the definitions of the same paradigm. These problems were also evident in the 'quality criteria' initially used in the analysis of Case Studies 1 to 3 in the previous chapter.

The analysis in Table 4.4 suggests that neither Wellington nor Chandler's frameworks suffer from the problem of inadequacy. Squires and McDougall (1994) point out that earlier software frameworks tended to have fewer categories and that later ones tended to add in more types of software. This may explain why Wellington and Chandler's frameworks do not suffer from the problem of inadequacy in relation to these case studies, but suggests that as new types of software are developed there is a danger that this problem may also apply to them.

Wellington and Chandler's frameworks also appear, from the analysis in Table 4.4, to avoid the problem of ambiguity. However, it is clear that the categories they use are not discrete, in the sense of there being no overlap between them. Indeed, Chandler himself identifies that his categories are not clear-cut and that the order in which they appear along his 'Locus of Control' dimension may vary.

The analysis of the three case studies represented in Table 4.4 highlights another important problem with all of the software frameworks: they do not provide a sufficiently rich picture to distinguish between the different uses that were made of computers either across the three different case studies or across time within an individual case study. As all the software available on the laptops was 'content-free' every instance of the use of the laptops in the three case studies would fall within the same category(s) on each of the four different frameworks. Tables 4.5 to 4.8 show the outcome of applying each of the four exemplar software frameworks to the three case studies.

Table 4.5 Analysis of the three case study classrooms using Wellington's framework

	Case study classroom		
Period	**5DS**	**4JJ**	**2BH**
1	**Tools**	No use	**Teaching programs, Learning programs & Tools**
2	**Tools**	No use	**Learning programs**
3	**Tools**	No use	**Teaching programs, Learning programs & Tools**
4	**Tools**	**Tools**	**Teaching programs, Learning programs & Tools**
5	**Tools**	*N/A*	**Teaching programs & Tools**
6	**Tools**	*N/A*	**Teaching programs & Tools**

Table 4.6 Analysis of the three case study classrooms using Taylor's (1980) framework

Period	Case study classroom 5DS	4JJ	2BH
1	**Tool**	No use	**Tutor & Tool**
2	**Tool**	No use	**Tutor & Tool**
3	**Tool**	No use	**Tutor & Tool**
4	**Tool**	**Tool**	**Tutor & Tool**
5	**Tool**	*N/A*	**Tutor & Tool**
6	**Tool**	*N/A*	**Tutor & Tool**

Table 4.7 Analysis of the three case study classrooms using Kemmis *et al.*'s framework

Period	Case study classroom 5DS	4JJ	2BH
1	**Emancipatory /Unclear**	No use	**Instuctional, Revelatory, Emancipatory/Unclear**
2	**Emancipatory /Unclear**	No use	**Revelatory, Emancipatory/Unclear**
3	**Emancipatory /Unclear**	No use	**Instuctional, Revelatory, Emancipatory/Unclear**
4	**Emancipatory /Unclear**	**Emancipatory /Unclear**	**Instuctional, Revelatory, Emancipatory/Unclear**
5	**Emancipatory /Unclear**	*N/A*	**Instuctional, Emancipatory/Unclear**
6	**Emancipatory /Unclear**	*N/A*	**Instuctional, Emancipatory/Unclear**

Table 4.8 Analysis of the three case study classrooms using Chandler's (1984) framework

Period	Case study classroom 5DS	4JJ	2BH
1	**Content free tool**	No use	**Tutorial, Simulation Games & Content free tool**
2	**Content free tool**	No use	**Simulation Games**
3	**Content free tool**	No use	**Tutorial, Simulation Games & Content free tool**
4	**Content free tool**	**Content free tool**	**Tutorial, Simulation Games & Content free tool**
5	**Content free tool**	N/A	**Tutorial & Content free tool**
6	**Content free tool**	N/A	**Tutorial & Content free tool**

Despite the fact that there were substantial differences in practice across these contexts (as described in the previous chapter) the analyses shown in Tables 4.5 to 4.8 show that in each case the framework does not provide sufficient detail of key aspects of practice in each context to enable us to distinguish between them. Thus, it is not possible using any of these software framework to distinguish between: Periods 1 to 6 for Mrs Smith's class; Periods 5 and 6 for Mrs Humphries' class; and 5DS and 4JJ in Period 4. Taylor himself was clearly aware of this limitation of his own framework and stated that "it [his framework] can divert attention from relevant insights when used too slavishly" (Taylor 1980 p.10).

One approach to overcoming this problem of insufficient richness of description to enable useful distinctions to be made might appear to be to increase the number of categories within the framework. However, this would still not reveal key facets of the differences between the computer use within these three case studies. This is because the key aspects of the practice in the three case study classrooms related to the way in which they made use of the software; the same software was used in very different ways within these case studies.

Furthermore, these frameworks may actually distort the picture because of their focus on the software *per se* rather than on the way in which it is actually used in a specific context. For example, software frameworks tend to engender value judgments about the most effective ways to use computers. This was highlighted as one of the problems with the 'quality criteria' in the previous chapter. These value judgments may be implicit, for example in a sequential ordering of categories (see Figure 4.2), or in superordinate categories (e.g. Kemmis *et al.*'s 'Emancipatory paradigm'). They may be explicit as in Taylor's (1980) discussion of Tutor, Tool and Tutee, in which he identifies that using computers in the Tutee mode is the most educationally beneficial.

Figure 4.2 Sequential ordering of categories, which implicitly suggests progression in educational effectiveness

	Less effective	←→				**More effective**
Wellington (1985)	Teaching programs	Learning programs			Tools	Open ended software
Taylor (1980)	Tutor				Tool	Tutee
Kemmis *et al.* (1977)	Instructional	Revelatory			Conjectural	
Chandler (1984)	Tutorial	Games	Simulation Games	Experimental simulation	Content free tools	Programming languages

Within the three case studies these frameworks therefore, at least implicitly, suggest that the use of spelling software (in 2BH) is less educationally effective than the use of a word processor (in all three classes), just as happened with the 'quality criteria' in the previous chapter. This conclusion is based on a value judgment about the relative educational merits of different types of software use and an assumption that the software is always being used effectively. Comparing the use of the spelling software in 2BH (throughout Periods 1 to 6) with the use of a word processor by a child in 5DS to copy type her work because she had forgotten to send it to the typing pool (Period 1) illustrates an important problem with this logic, and with software frameworks more generally. In this example, the spelling software was used in short targeted bursts by children in 2BH in order to reinforce letter blends that they were focusing on in their language work within the class. Whilst there is no data about the effect that this use of the software had on children's achievement it had a clear educational objective and was implemented in a way that ought to have maximized its impact. The use of the word processor in 5DS on this occasion on the other hand did not have any educational objective and as such it is unlikely that it enhanced the child's learning. It would seem reasonable to conclude that in this case the use of the spelling software was educationally more effective than the use of the word processor.

Thus, not only do these frameworks not provide a sufficiently rich picture to enable important distinctions to be made between different uses of computers but they also potentially present a distorted view of the quality of that use. The underlying problem is that software frameworks, by their very nature, focus on the software itself; the software is used as the basis for defining the categories within these frameworks. Software frameworks suffer from the problem of technological determinism – in focussing on the software decontextualised from its actual use in practice they assume that the software determines the way in which it will be used. This is clearly not the case, as is illustrated by the ways in which the children in the first case study class (5DS) used word processing software: during Period 1 to copy type material that they had already written in full by hand (field notes 9th Nov; Period 4, manual log 22nd Feb & 2nd, 3rd, 9th Mar); during Periods 2 and 3 to type up resolutions which they had planned initially on paper (Mrs Smith, 7th Feb); and during Period 5 to draft and re-draft text on screen for their 'class books' (Mrs Smith, 15th June).

This focus on the software itself is a fundamental flaw with Software frameworks, which Kemmis *et al*. (1977) seem to have been aware of. They explicitly state that the way in which computers are used in a learning context can undermine the intentions of the developer and go on to provide examples to illustrate this point for each of their paradigms. This essential truth, that one cannot base a useful framework for thinking about the educational practices surrounding computer use on software in the abstract, decontextualised from the way in which it is used, led Squires and McDougall (1994) to develop their own framework, which fits into the Pedagogical frameworks category.

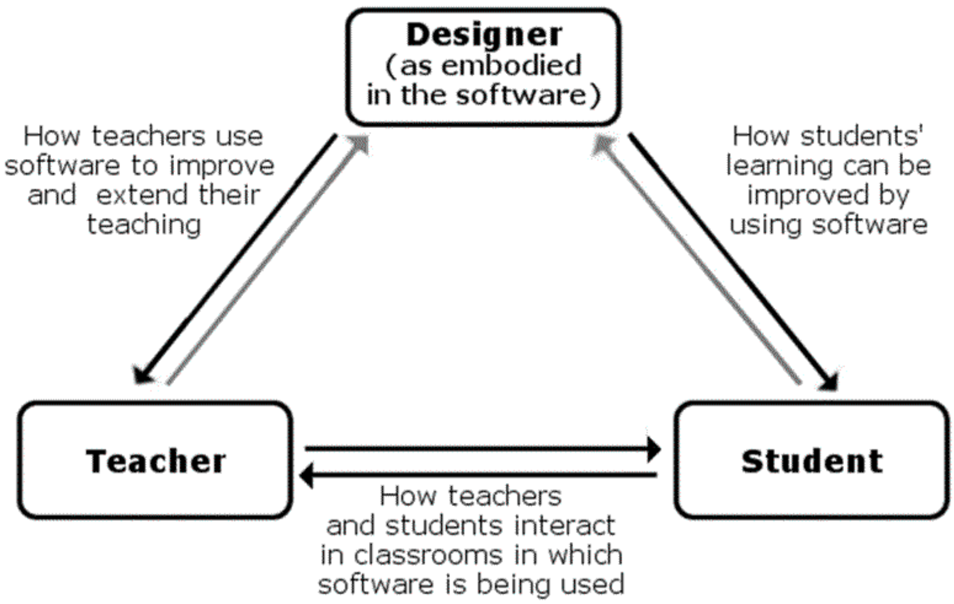
Pedagogical frameworks

Pedagogical frameworks are characterised by a focus on the educational practices surrounding computer use. Thus, unlike Software frameworks they focus on the ways in which computers are actually used in context. The two most significant frameworks in this category in 1994 were Squires and McDougall's Perspectives Interactions Paradigm (PIP) and the National Council for Educational Technology's (1994) framework, called 'Reviewing IT'. Whilst both focus on the practice surrounding computer use these two pedagogical frameworks adopt quite different approaches and each highlight different issues of relevance to this study.

The Perspectives Interactions Paradigm

Squires and McDougall's (1994) Perspectives Interactions Paradigm (PIP) is the classic example of a pedagogical framework. It places the emphasis on the interactions between three sets of key actors: student(s), teacher, and designer (of software), as illustrated in Figure 4.3.

Figure 4.3 A diagrammatic representation of the PIP



Using the PIP involves thinking about the interactions between each of the three pairs of actors. In their original description of the PIP Squires and McDougall (1994) assume that it will be used as a conceptual tool for evaluating the suitability of specific software for use in specific contexts. Thus, they talk about students and teacher as being generalised students (learners) and generalised teachers (people who support learners), whilst the designer encapsulates all the functions that go into developing some software. However, given the focus of this framework (and the others within this group) on how software is actually used in context it does not seem inappropriate to use the framework to describe how computers have been used. Indeed, Squires and McDougall themselves identify that "the use of this paradigm is not limited to software selection. It provides some basis for software evaluation, and it can be applied even more broadly" (Squires and McDougall

1994 p.117). The PIP " can provide a more general framework for thinking about the use of IT in educational settings" (McDougall and Squires 1997 p.118). It is therefore legitimate to evaluate the PIP in terms of the degree to which these three sets of interactions prove useful in thinking about the three case studies.

When dealing with what Squires and McDougall refer to as the 'Teacher and Student Perspective Interaction' the focus is on interactions between teachers and students (learners) and between student (learner) and student (learner). Squires & McDougall highlight that this needs to include both those interactions that take place at the computer as well as those related interactions that take place elsewhere but are 'generated by' the computer. They suggest a range of questions that one might ask about these interactions, which relate to different dimensions of practice. Their suggested questions relate to: the kinds of classroom activities; the kinds of interactions; the way in which the computer use is organized (e.g. groupings, on and off computer work, etc); the degree to which students take control of their own learning; the degree of teacher intervention; the kind of teacher interventions; the teacher's role; the students' roles; and the style of classroom management.

Analysing the three case studies in terms of possible dimensions of computer use quickly revealed a similar, though differently organised set of dimensions of practice (see Table 4.9).

Table 4.9 Dimensions of practice emerging from the three case studies

Curriculum 'content'	Balance of focus on learning about IT or using IT as a tool to support learning about something else (e.g. move from learning about IT to using IT to support language work in 5DS).
Curriculum Emphasis	The extent to which the activity deals with content rather than process (e.g. The use of Spell Star in 2BH was focused on content (knowledge about letter blends) whereas the use of the Light pen software was focused on the process of letter formation).
Curriculum access	The extent to which children have access to the curriculum (e.g. The children in 4JJ had very limited access to the IT curriculum during Periods 1 to 3).
Distribution of class time	**Subject timetable** - Computing activities have identified time slots with pre-defined start and end times (e.g. Laptop use in 4JJ). **Core/other timetable** - identified time slots for IT plus subsumed or integrated with other subjects on the timetable (e.g. Use of laptops in 5DS). **Integrated** - IT is not identified as having a specific time slot (e.g. Use of drill and practice software in 2BH)
Flexibility of class time	**Rigid** - Start and end times adhered to. Move onto next activity/subject when end time reached even if previous activity not finished. May be finish off activities when have finished timetabled work, in playtimes or in specific 'finishing off slots' (e.g. Use of laptops in 4JJ). **Flexible** - Start and end times are clearly identified but may be varied if an activity is not finished - i.e. miss out or put off another activity in order to finish the current one (e.g. Children in 5DS missing PE in order to finish work on laptops). **Fluid** - No specified start and end times though may be targets set - activities take different times for different children (e.g. Use of drill and practice in 2BH).
Planning	Planning is used here to include time thinking about the activity, relating it to learning outcomes, etc. Sub-dimensions of planning include such things as: • the degree to which an activity is planned; • who does the planning (The class teacher, another teacher (e.g. Special needs teacher in 5DS), another member of staff (e.g. Nursery Nurse in 4JJ), other (e.g. a parent in 2BH); • the amount of time spent planning an activity.
Preparation	Preparation used to include collecting together resources and actually setting up the activity once it has been planned. Sub-dimensions of preparation include: familiarisation with the hardware/software (e.g. DS and BH both used the laptops at home in order to familiarise themselves with the software); preparing resources (e.g. Nursery nurse in 4JJ prepared a 'worksheet' for use with the Mary Rose painting activity); setting up equipment (e.g. setting up the laptops & printers).
Teacher's time on Delivery	How much time the teacher spends on the activity (i.e. with the children).
Distribution of teacher's time	How the teacher uses her time on the activity (e.g. teaching, directing, monitoring, assessing, trouble shooting).
Recording time	Amount of time spent on maintaining records (e.g. 2BH's Computer Notebook)
Use of other adults' time	The extent to which other adults (i.e. not the teacher) spend working with the children (e.g. nursery nurse in 4JJ; parents in 2BH; Special needs teacher in 5DS)
Groupings	How the children are grouped, which includes a number of sub-dimensions (see Table 4.10 for more details)
Ways of working	**Individual** - each child has a separate task. The intended outcomes for the children are thus different with each child completing a different assignment (e.g. Individual child working with Special needs teacher in 5DS). **Parallel** - each child has the same task but completes it independently of the other children (e.g. Children working on New Year Resolutions in 5DS) **Co-operative** - the pupils all working towards a joint outcome but each child has a different task to perform within it (e.g. Children working on class book in 5DS). **Collaborative** - Each child is working on the same task and there will be one joint outcome (e.g. Children working on word processing a letter in 5DS).
Control	The extent to which the teacher or child controls the activity (e.g. DS instigated and directed the computer use in Periods 2 and 3 whilst the children in 5DS appeared to instigate and have much more responsibility for the computer use in Period 5).
Sources of expertise	The range of sources of expertise that the children are allowed to draw upon (e.g. Teacher, other adults, other children)
Teacher fallibility	Infallible teacher **=>** teacher as expert => teacher as learner (e.g. DS was happy to acknowledge that she did not know a great deal about the PowerBooks and for the children to show her how to use them).
Audience	Audiences evident in the case studies included: the child; the class teacher; the class (e.g. 5DS shared resolutions with class, Mrs Smith, 7th Feb); other members of the school (e.g. The class books in 5DS, Mrs Smith, 15th June); parents (e.g. The display in 2BH); other people outside the school (e.g. Letters in 2BH and 5DS)
Records kept	What records are kept (e.g. Samples of work in 5DS; Computer Notebook in 2BH).

Squires and McDougall (1994) do not go into any detail about any of the dimensions that they mention. Thus for example, whilst they suggest some sub-dimensions of ways of organizing computer use they do not attempt to provide what they consider to be a definitive list of these. It is clear that many of the dimensions listed in Table 4.9 can be further sub-divided. Table 4.10 illustrates this for one of the dimensions that was evident in the three case studies and that was explicitly referred to by Squires and McDougall, namely 'groupings'.

Table 4.10 Some possible sub-dimensions of groupings

Dimensions of Groupings	Examples from case studies
Number	4 groups (e.g. 5DS, field notes 23rd Nov)
Size	Whole class (e.g. 5DS, field notes 7th Feb; 2BH, Mrs Humphries, 16th May) 8 children (e.g. 5DS, field notes 16th Nov; 4JJ, Mr Jones, 10th Nov) 4 children (e.g. 5DS, field notes 16th Nov) 3 children (e.g. 5DS, Mrs Smith, 15th June) 2 children (e.g. 5DS, Mrs Smith, 7th Feb; 2BH, field notes 12th Oct; 4JJ, Obs 1st Mar) 1 child (e.g. 5DS, field notes 9th Nov; 2BH, Manual logs; 4JJ, Mr Jones, 10th Nov)
Basis	Ability (e.g. 5DS, field notes 16th Nov; 2BH, Mrs Humphries, 30th Nov) Mixed ability (e.g. 2BH, Mrs Humphries, 30th Nov; 4JJ, Mr Jones, 28th Apr) Peer tutoring (e.g. 5DS letters from children 4th Mar; 5DS/2BH field notes 15th Jun) Friendship (e.g. 4JJ, Mr Jones, 28th Apr) Not age (e.g. 5DS/2BH Mrs Smith 15th Jun; Mrs Humphries, 30th Nov; 5DS/2BH field notes 15th Jun) Vertical grouping (e.g. Mr Jones, 10th Nov) Family (e.g. Mrs Humphries, 30th Nov)
Delineation	Clear – groups not interacting with each other Fuzzy – interaction between groups (e.g. 5DS, Mrs Smith 7th Feb)
Stability	Fixed for term/year (e.g. 2BH, Mrs Humphries, 30th Nov; 4JJ, Mr Jones, 10th Nov) Fixed for lesson (e.g. 4JJ, Nursery Nurse, 3rd May) Flexible (e.g. 5DS, Obs 7th & 9th Feb)
Location	Withdrawal groups (e.g. 4JJ, Obs 8th Mar)

This analysis highlights a key weakness with the PIP, which is that it is too complex, in terms of requiring the use of too many dimensions, and thus lacks utility. There are two different facets to this. Firstly collecting data relating to all of these dimensions would not be straightforward and would be very time consuming (see the next chapter for a discussion of the difficulties of collecting data in the three case studies). Secondly, even if all the data were available and had been analysed, the picture created would be too complex to provide a clear picture that would allow comparisons to be made across contexts.

The situation is made even more difficult by the fact that Squires and McDougall make no attempt to define the dimensions that their framework is based upon. This undermines the degree to which people will have shared understandings of these dimensions and hence of its potential to overcome the problems identified at the beginning of this chapter. Squires and McDougall (1995) themselves acknowledge that the key weakness with the PIP is that it is difficult and time consuming to apply.

Thinking about the 'Designer and the Student Perspectives Interaction' involves considering the interaction between the designer, as embodied within the software, and the students. Squires and McDougall argue that the view of learning that is held by the designer underpins the possible interactions between the designer and the students. This is because this view of learning will have informed and shaped the design of the software.

Squires and McDougall suggest that there are two main 'educational approaches' underpinning most educational software: behaviourist, as exemplified in drill and practice software for example, and constructivist (in the Piagetian sense), as exemplified in 'microworlds' for example. They go on to suggest that there are three key aspects of software design, which relate to these underpinning theories. These are the extent of learner control, the complexity of the material presented to the learners, and the challenge felt by the learners.

The degree to which the software succeeds in embodying the designer's view of learning will vary, as will the degree to which this underlying educational design is made explicit to users of the software. Squires and McDougall (1994 p.91) provide a table that summarises the position expected for behaviourism and constructivism against learner control, complexity and challenge (see Table 4.11).

Table 4.11 The relationship between the three key aspects of software design and its underpinning learning theory

		Key theories of learning	
		Behaviourism	Constructivism
Key aspects of software design	Extent of learner control	Little or no control. Learners as passive consumers	Significant levels of control. Learners active, purposeful participants
	Complexity of material presented to learners	Highly structured, simple formats, small incremental steps, positive feedback.	High
	Challenge felt by learners	Artificially contrived, extrinsic rewards.	Intrinsic rewards (based on satisfaction in completing tasks or succeeding in understanding environment).

Table 4.12 shows how the Designer-Student Interaction Paradigm might be applied to the use of Spell Star (a drill and practice program) in 2BH.

Table 4.12 Analysis of the use of drill and practice software in 2BH on the Designer-Student Interaction Paradigm

2BH Period 2 - Spellstar	Classification	Description/Evidence
Extent of learner control	Behaviourist	Teacher decided upon task and which letter blends to focus on. Software controlled interaction – asking for children's responses.
Complexity of material presented to learners	Behaviourist	Highly structured tasks, simple formats, small incremental steps, positive feedback.
Challenge felt by learners	Behaviourist	Artificially contrived, extrinsic rewards built into software.

Squires and McDougall point out that some software may not have an underpinning learning theory and suggest that this is indicative of software that is unlikely to support learning directly, although it may help manage the administrative side of learning. Content free software, such as that provided on the laptop computers, would fall into this category of software without an underpinning learning theory, at least in part because it was not originally designed for educational use. However, it is clear that such software can be embedded in a learning activity, as happened in each of the three case studies, in a way that does embody an underpinning learning theory. This either indicates a gap in the PIP (i.e. lack of adequacy as was identified for some Software Frameworks) or that when using the

PIP to analyses computer use it is legitimate to apply the framework to such software embedded within a learning activity.

Using the student-designer interaction paradigm to analyze examples of computer use from each of the case studies (see Tables 4.12 to 4.15) reveals the key weakness with this framework, which paradoxically is also one of its strengths. The framework suffers from the problem of ambiguity identified in relation to software frameworks; it is often unclear whether a specific example of computer use falls into the behaviorist or constructivist classification. For example, the use of a word processor in 5DS to produce new year resolutions (Table 4.13) seems to include elements that Squires and McDougall would argue span both theories (see Table 4.11). This is also the case for the use of painting software in 4JJ to create pictures of the Mary Rose (Table 4.14). This undermines the usefulness of the framework.

Table 4.13 Analysis of the use of a word processor during Period 2 in 5DS on the Designer-Student Interaction Paradigm

5DS Period 2 - Word processing resolutions	**Classification**	**Description/Evidence**
Extent of learner control	Constructivist	Focus specified by teacher, and child knew what they were going to type before coming to computer. Child had free rein to experiment with design (font, size, style, etc).
Complexity of material presented to learners	Unclear	The text being created was very constrained both in length and content (had to be a new year resolution, which the child had already decided upon), but the child was free to experiment with its formatting. The development of the text was structured with small steps (discussion of resolution, write notes/plan resolution, type in resolution, experiment with font, style, etc. Print two copies).
Challenge felt by learners	Unclear	The activity was artificially contrived in the sense that the teacher decided upon the task (writing a new year resolution). The use of the computer allowed the children to enhance the appearance of their work – which provided intrinsic motivation in as much as the reward was the appearance of what they produced.

However, using the framework did force close examination of specific aspects of each of the instances of computer use, helping to enrich the picture presented by focusing attention on important facets of that use. This can be seen in the descriptions/evidence presented in

Tables 4.12 to 4.15. McDougall and Squires (1995) argue that this 'generative approach', in which the framework focuses attention but does not tightly specify the details of the analysis, is one of the great strengths of the PIP. They also acknowledge that this makes using the PIP much more difficult as it requires the user of the framework to customize it for their particular context.

Table 4.14 Analysis of the use of a painting program in 4JJ on the Designer-Student Interaction Paradigm

4JJ Period 4 – Painting Mary Rose	Classification	Description/Evidence
Extent of learner control	Unclear	Focus of activity (drawing Mary Rose) tightly controlled by 'teacher'.
Complexity of material presented to learners	Unclear	Activity very structured – building up Mary Rose diagram in small incremental stages, based on worksheet.
Challenge felt by learners	Unclear	Artificially contrived – in sense of 'teacher' telling children that they were going to draw diagrams of Mary Rose. Though this did fit within the overall theme being studied in the class. Intrinsic rewards in the quality of their picture (no extrinsic reward mechanism within software).

Table 4.15 Analysis of the use of a word processor during Period 5 in 5DS on the Designer-Student Interaction Paradigm

5DS Period 5 - Word processing class books and newspaper	Classification	Description/Evidence
Extent of learner control	Constructivist	Unplanned use of computer and use spread more evenly throughout week (suggesting greater learner control).
Complexity of material presented to learners	Constructivist	Children composing on screen, editing and formatting. More complex and open ended than word processing of resolutions.
Challenge felt by learners	Constructivist	Whilst the overall activity was artificially contrived in the sense that the teacher decided upon the tasks (writing class books and a newspaper), the children appear to have chosen to use the computer and to have had much more freedom in what they did. The use of the computer allowed the children to experiment and refine their work and generated a good deal of enthusiasm.

Associated with this problem of ambiguity and the strength of having a generative framework is the issue of the ease with which one can compare the descriptions of practice that emerge as a result of using the framework to analyse practice. In most instances of computer use there are elements from both the behaviorist and constructivist models, as presented by Squires and McDougall. This means that in order to make comparisons between different instances of computer use one needs to look at the detailed descriptions of that use that are produced, not just the higher level classifications. For example, a comparison of the level of user control when 5DS used a word processor to produce their new year resolutions (Table 4.13) and to produce their class books and newspaper (Table 4.15) suggests that both fall into the Constructivist classification. However, closer examination of the detailed descriptions for each set of activities reveals substantial differences between them.

The key issue when thinking about the 'Designer and Teacher Perspectives Interaction' is the degree of match between the designer's view of the curriculum, as embodied within the software, and that of the teacher who is using the software. Squires and McDougall use 'curriculum' to include both the educational content and process. As with the underlying theory of learning that underpins the software, the degree to which the curriculum is made explicit within the software will vary, or may be absent (e.g. in the case of software that was designed for use in a business rather than an educational context). Again this raises an issue about whether this signifies that the PIP is inadequate in not addressing this type of software, or whether it means that in using the PIP one needs to apply it to the software embedded within a learning activity. Squires and McDougall (1994) imply the latter is appropriate when they suggest that one of the key issues to be addressed when thinking about the designer-teacher perspectives interaction is the extent to which the educational possibilities of the use of software which initially has no explicit or implicit curriculum aims are realized.

Squires and McDougall highlight a number of facets of the Designer-Teacher interactions that are important. These include identification of the implicit curriculum aims within the software, and the degree of match between the explicit and implicit curriculum aims in the software with the teacher's specific curriculum requirements. They also note the need to identify the extent to which the implementation of the software has 'subverted' the explicit and implicit curriculum aims in the software, in order to meet the teacher's specific curriculum requirements.

Table 4.16 Analysis of the use of drill and practice software in 2BH on the Designer-Teacher Interaction

2BH Period 2 - Spellstar	Description/Evidence
Implicit/Explicit curriculum within software	Reinforcing specific letter blends, enhancing spelling competence
Implicit/Explicit curriculum in activity	Reinforcing specific letter blends, enhancing spelling competence
Teacher's curriculum requirements	Reinforcing specific letter blends, enhancing spelling competence
Match between curriculum in activity and curriculum requirements	Close match

Table 4.17 Analysis of the use of a word processor during Period 2 in 5DS on the Designer-Teacher Interaction

5DS Period 2 - Word processing resolutions	Description/Evidence
Implicit/Explicit curriculum within software	None
Implicit/Explicit curriculum in activity	Learning to use the software, experimenting with formatting text
Teacher's curriculum requirements	Learning to use the software, experimenting with formatting text
Match between curriculum in activity and curriculum requirements	Close match

Table 4.18 Analysis of the use of a painting program in 4JJ on the Designer-Teacher Interaction

4JJ Period 4 – Painting Mary Rose	Description/Evidence
Implicit/Explicit curriculum within software	None
Implicit/Explicit curriculum in activity	Learning how to operate software (explicit). Learning about the composition of drawings (implicit)
Teacher's curriculum requirements	Learning how to operate software
Match between curriculum in activity and curriculum requirements	Close match

Table 4.19 Analysis of the use of a word processor during Period 5 in 5DS on the Designer-Teacher Interaction

5DS Period 5 - Word processing class books and newspaper	Description/Evidence
Implicit/Explicit curriculum within software	None
Implicit/Explicit curriculum in activity	Enhancing literacy – editing and refining text, learning how to peer tutor
Teacher's curriculum requirements	Unplanned activity – so none initially. Teacher recognized value of activities in supporting children's literacy and peer tutoring as activities developed
Match between curriculum in activity and curriculum requirements	Close match

As with previous pairs of interactions this one does help focus attention on important aspects of the activities, and hence helps develop richer descriptions of those activities (see Tables 4.16 to 4.19). However, this analysis seems to assume that all activities have some curriculum objective. In the case of 4JJ the analysis in the previous chapter indicated that this did not seem to be the main driver for the use of the computers. Had that analysis been based on the PIP it seems likely that this may not have come to light. This is another limitation with this framework.

Overall, the key problem identified with the PIP in this analysis has been that the definitions of the sub-dimensions within each of the pairs of interactions within the PIP are too vague – they suffer from the problem of ambiguity mentioned in relation to Software Frameworks. Another facet of this ambiguity is the lack of clarity in the definition of the PIP about the ways in which the Interaction Paradigms, between the three pairs of actors, interact. The triangular representation of the three different pairs of interactions within the PIP (Figure 4.3) does seem to indicate that there are interconnections between them. However, it is by no means clear what those inter-relationships are. This makes it very difficult to generate a holistic picture on the basis of the PIP, and this in turn means that it is very difficult to get an overview of the practice being examined on the basis of an analysis based on the PIP.

Squires and McDougall argue that the ambiguity within the PIP is a positive feature of the framework, which they describe as being generative. They claim that by leaving the definitions of the components of the pairs of interactions vague the PIP will support thinking about the practice surrounding computer use without constraining that thinking to a limited number of pre-defined dimensions. However, the ambiguity in the definition of each of the interaction paradigms and in the interconnections between them renders the PIP much less useful as a framework for making comparisons across contexts.

Reviewing IT

Reviewing IT (NCET 1994) was designed as a framework for evaluating the quality of practice surrounding computer use in primary classrooms. It consisted of sets of criteria based on indicators of quality, which were structured around the OFSTED Framework for the inspection of schools (OFSTED 1994). According to its authors the 'Reviewing IT' framework provides a structure that identifies nine factors which contribute to the quality of pupil's learning outcomes (which the Framework describes as 'Standards of Achievement' and 'Quality of Learning') and which can be evaluated without prolonged observation of pupils in classrooms. Thus, they were claiming that the framework could be applied easily. However, the extent to which any framework that purports to evaluate educational practice can claim to result in valid descriptions of that practice "without prolonged observation of pupils in classrooms" seems questionable. The reasons for this are explored in detail in the following chapter, as part of a discussion of the problems associated with collecting data about computer use.

The authors of 'Reviewing IT' go on to claim that it provides "a set of quality indicators that are both coherent and comprehensive" and which "represent a strong professional view and are being used by many inspectors to inform their judgements" (NCET 1994 p.3). The way in which the framework manages to be "comprehensive" is by having a large number of dimensions. The framework consists of nine indicators of quality (see Table 4.20), each of which is further subdivided into between 2 and 10 criteria (e.g. see Table 4.21 which shows the sub-dimensions of one of these nine indicators of quality). Thus, there are nearly 40 individual statements within the framework as a whole. This suggests that applying the framework would be time consuming and require a great deal of data collection.

Table 4.20 The nine indicators of quality

1. Teaching 2. Assessment, Recording and Reporting 3. The Curriculum 4. Equal Opportunities 5. Provision for pupils with Special Educational Needs 6. Management and administration 7. Teaching and non-teaching staff 8. Resources for Learning 9. Accommodation

Furthermore, it is clear from Table 4.21 that these criteria suffer from all the same problems that beset the indicators of quality used in the original analysis of the three case studies. They are value laden in the sense of engendering a particular set of views about what constitutes effective use of computers. They are ambiguous, in the sense that the definition of each of the sub-dimensions is open to interpretation. For example, criteria 1.2 of Teaching (see Table 4.21) is followed by the phrase 'where appropriate', which clearly lacks specificity, and is potentially open to widely varying interpretation.

Table 4.21 The definition of one of the nine indicators of quality

Indicator 1: Teaching	
Where teaching with or about IT is good, the following statements are likely to be true:	
1.1	Individual lesson planning takes account of the school's agreed approach to the development of IT capability.
1.2	Lesson objectives identify specific gains in IT capability, where appropriate.
1.3	The teacher takes pupils' prior experience with IT (gained in and out of school) into account when planning lessons.
1.4	Lessons exhibit adequate differentiation such that tasks set match the needs and abilities of pupils.
1.5	The teacher successfully exploit the power of IT to motivate learning and to sustain pupils' interest.
1.6	IT is used to enhance both teaching and learning in a range of subject contexts.
1.7	The teacher adopts classroom management strategies which reflect the availability and use of IT resources.
1.8	A teacher with restricted experience of IT does not allow this to limit the opportunities that they provide to pupils.
1.9	The teacher exploits those occasions when some pupils have IT skills which they, themselves, have not yet acquired.
1.10	Available support (internal or external to the school) such as technicians, teachers with an IT specialism or SEN specialists is used by the teacher to best effect.

In addition, applying these criteria sometimes leads to a mis-evaluation of the quality of practice, even where one agrees with the view of effective computer use implicit within the framework. For example, in the view of both the teacher and researcher the most educationally effective use of computers in 5DS occurred in Period 4 when the work was not initiated by Mrs Smith and was largely unplanned (see the analysis of the quality of computer use for Case Study 1, pp.81-101). Using the NCET framework this computer use would be evaluated as being of low quality on the basis of the lack of planning (see Criteria 1.1 to 1.3 in Table 4.21). This framework suffers from a lack of accuracy, in the sense that the descriptions resulting from it may conflict with other descriptions, which might be generated using other frameworks even where both frameworks share the same underpinning values about how computers ought to be used in education.

One of the strengths of the framework is that it does address the issue of creating an overview of the practice that it is describing. It does this by synthesising out one quality rating for each of the nine indicators of practice, which can be further amalgamated to give one overall quality rating spanning all nine indicators. The advantage of this is that it then becomes very easy to make comparisons across contexts. The danger is that those comparisons are invalid because the original descriptions based on the individual criteria were invalid and/or because the process of amortising them into a single value distorted the description still further.

Evolutionary frameworks

Evolutionary frameworks are characterised by a focus on the way(s) in which computer use changes over time. Thus, they focus on 'phases' or 'stages' in the embedding of ICT. There are three different, though related groups of frameworks within this category, which deal with different aspects of computer use. The first is structured around the evolution of computer use in education (e.g. Heppell's (1993b) four stage model of the evolution of educational computing). The second concentrates on the phases that a teacher's beliefs and practices about computer use in education go through (e.g. Dwyer *et al.*'s (1990) five-phase model of teacher development). The third group of evolutionary frameworks addresses the stages that a teacher's classroom management follows (e.g. Sandholtz *et al.*'s (1990) Teachers' concerns framework).

The key difference between the first group of evolutionary frameworks and the other two is that it is not looking at the level of the individual classroom. However, it could be argued that all three of these sets of frameworks could be equally helpful in describing computer use at a range of levels, including at the level of an individual school or classroom. The distinction between the second and third group of evolutionary frameworks was made by Sandholtz *et al.* (1990). It is based on the difference between teacher's 'beliefs and practices' and their 'classroom management' which Sandhotlz *et al.* (1990) describe as 'instruction' and 'management' respectively. They acknowledge that 'instruction' and 'management' are intimately linked, but insist that the distinction is an important one.

Heppell's 4 Stage Model of the evolution of educational computing

Heppell (1993b) presented a model that shows stages, which he argues the use of computers in educational institutions (schools) progresses through. The model has four stages, which Heppell linked with the three stages of progression within his "developmental taxonomy of modes of interaction that integrated media should support." (Heppell 1993a p.242).

Table 4.22 Heppell's 4 Stage Model of the evolution of computer use mapping onto his taxonomy of modes of interaction for integrated media

<table>
<tr><th colspan="2">Heppell's 4 stage Model</th><th colspan="2" rowspan="2">Heppell's taxonomy of modes of interaction</th></tr>
<tr><td>Stage 1: Topicality</td><td>Focus is on learning about the technology.</td></tr>
<tr><td rowspan="2">Stage 2: Surrogacy</td><td rowspan="2">The computer is used as a 'surrogate teacher'.</td><td>Narrative</td><td>Initiate, watch and listen.</td></tr>
<tr><td>Interactive</td><td>Browse, explore, navigate and choose.</td></tr>
<tr><td>Stage 3: Progression</td><td>Focus on use of generic tools.</td><td rowspan="2">Participative</td><td rowspan="2">As 'interactive', plus originate and present.</td></tr>
<tr><td>Stage 4: Pedagogic Evolution</td><td>Computers alter the learning environment and the learners. This stage involves radical change.</td></tr>
</table>

Heppell (1993b) stated that Topicality was the first stage that computer use went through and that "the learner was seen as deficient, unfamiliar, and indeed relatively few children typically had any experience of using a computer" (p.230). It then progressed to Surrogacy which was characterised by the computer being used "as a surrogate teacher, containing a discrete and relatively small body of expertise which could be trickle fed to the 'empty vessel' learner." (p.231). Initial movement into the Progression stage involved the use of 'useful little programs' and then content free applications which had been developed initially for business (e.g. word processors). Heppell (1993b) argued that moving to the final stage would involve radical change that took into account the new skills and opportunities that ICT made available and that children were taking advantage of in their out of school lives (particularly in the context of playing computer games). He went on to say that generally this stage had not been reached, and that:

> "Stage Four will occur only when the new information capabilities of the 'information generation' are implicitly recognised and pedagogy begins to reflect the radical changes in traditional methods and assumptions that are on offer from rapid hardware and software evolution."
>
> (Heppell 1993b p.235)

Heppell presented his four stages as a progression through which computer use in education moves, each new stage building upon, rather than replacing, the stage before. However, Heppell (1993b) did not see this progression as being sequential, in the sense that he noted that new technologies often start back at Stage 1. He illustrated this with reference to the introduction of CD-ROM technology, where initially much of the focus was on the technology itself (i.e. topicality). He argued that this then progressed on to looking at how CD-ROM (alias multimedia) could be used in a surrogacy role to generate financial savings (for example in the first phase of the Teaching and Learning Technology Programme (TLTP) in UK higher education). This suggested that one might end up in the anomalous position of computer use within one class falling into more than one category at the same time. Indeed, this is what appeared to happen when this framework was used to analyse the three case studies (see Table 4.23). For example, 2BH used Drill and Practice software (Stage 2 Surrogacy) and generic tools (Stage 3 Progression) at the same time.

A similar, but even more paradoxical issue appeared to arise in relation to the use of content free software in all three case studies. Using content free software falls within Stage 3 (Progression), but the main focus for much of the time within each of the case studies was on learning how to use the technology, which falls into Stage 1 (Topicality). This suggested that the same computer use could fit into two different Stages at one and the same time. This seemed improbable, and it may be that in applying Heppell's model the definition of the stages was misinterpreted. Thus, 'learning about the technology', which is the focus of Stage 1, may not include learning how to use the technology. If this were the case then the paradox of being able to place the same computer use into two different stages simultaneously would be overcome. However, it would also highlight that the definitions of the stages within Heppell's model are ambiguous.

Table 4.23 Analysis of the three case studies using Heppell's four stage Model

Period	Case study classroom		
	5DS	**4JJ**	**2BH**
1	Stage 3 (Very little use)	No use	Stage 2, Stage 3 & Unclear
2	Stage 3	No use	Unclear
3	Stage 3	Stage 2 (Very little use)	Stage 2, Stage 3 & Unclear
4	Stage 3 (Very little use)	Stage 3	Stage 2, Stage 3 & Unclear
5	Stage 3		Stage 2 & Stage 3
6	Stage 3 (Very little use)		Stage 2 & Stage 3

In applying Heppell's model to the three case studies it was clear that the quantity of computer use was an important factor that needed to be included within the analysis (See Table 4.23). The only mention of the quantity of computer use within Heppell's description of his model was where he identified that a low level of use was common in Stage 1. Ignoring the quantity of computer use would have resulted in a misleading picture being created. For example, the descriptions of Periods 1 to 6 in 5DS would have all looked very similar if the quantity of use had been ignored.

The analysis in Table 4.23 suggested that Heppell's model suffers from many of the same problems that were encountered with Software frameworks. For example, it was unclear how to classify the use of Adventure games within Heppell's model. Hence the 'Unclear' entries for 2BH in Table 4.23. In addition, the framework did not discriminate sufficiently between the computer use in different contexts. On the basis of this framework important differences within and between the case studies were lost. Thus, it was not possible, on the basis of Heppell's framework, to distinguish between: Periods 2, 3 and 5 in 5DS; Periods 1, 4 and 6 in 5DS; Periods 5 and 6 in 2BH; and between 5DS in Periods 2, 3 and 5, and 4JJ in Period 4.

The similarities between many of the problems encountered when applying Heppell's model and the Software frameworks to the three case studies was perhaps to be expected given that Stages 2 and 3 are based on a classification of the role that the technology plays. Thus Stage 2, a focus on the use of the computer as a surrogate teacher, equates to Taylor's Tutor, and Stage 3, the use of generic tools, equates to Taylor's Tool.

One other problem became apparent with this four stage model, related to the notion that the stages build upon one another in a progressive sequence. Progression through cumulative stages would seem to imply that all the stages operate along the same dimension(s) of practice. However, it is clear that the different stages within this model are based around different and apparently unrelated dimensions (see Table 4.24). This seemed to suggest that the notion of progression could not apply.

Table 4.24 Comparison of the different dimensions that seem to underpin Heppell's four stage model

Stage		Underlying dimension(s)
1: Topicality	Progression ↓	Extent to which focus is on 'learning about computers' or 'learning how to use computers'
2: Surrogacy		Software type (very similar to Taylor's model)
3: Progression		
4: Pedagogic Evolution		Degree of change or impact that computer use has on the content and processes of learning

Dwyer *et al.*'s (1990) five-phase model of teacher development

Dwyer *et al.*'s (1990) five-phase model of teacher development in high-tech classrooms was based on the ACOT (Apple Classrooms of Tomorrow) research. It focused on the 'stages of development' that ACOT teachers went through during the first four years of that project. In devising the framework a wide range of data were analysed, including: personal reports from teachers; weekly site reports; classroom observations; interviews with students, parents, and teachers; and cross-site assessment data supplemented by additional measures. These data were organised into around 13,000 learning/teaching episodes, which were analysed to look for changing patterns of teachers' practices and beliefs. It was from this that the five-phase model of teacher development emerged (see Table 4.25).

The language used in the framework reflected its origins in the USA. At times it was difficult to decide how to interpret this in the context of UK classrooms. For example, the descriptions of the Entry and Adoption phases both referred to 'lecture, recitation, and seat-work'. These were not terms that were commonly used in the context of UK primary education, and might have reflected differences in the cultural context in the UK and USA.

Table 4.25 Description of the five-phase model of teacher development

Phase	**Summarized as**	**More detailed description**
Entry	Traditional schooling, based on didactic models of teaching and 'knowledge transmission' firmly in place.	Includes the use of a range of 'text-based' technologies (e.g. textbooks, blackboards) to support 'lecture, recitation, and seat-work' (Dwyer *et al.* 1990 p.4).
Adoption	Use of new technology to support traditional model of didactic teaching.	Teachers' moved away from worrying about how to connect up and operate the technology and towards thinking about how to use it in their teaching. The technology was used "to support text-based drill-and-practice instruction. Students continued to receive steady diets of whole-group lectures and recitation and individualized seatwork." (Dwyer *et al.* 1990 p.5). Students' attendance levels increased, and their self-esteem and motivation were 'strong'. The levels of discipline problems reported were low. Students' performance on traditional measures of achievement did not alter on average, although teachers reported that individual pupils performed better.
Adaptation	Increasing student productivity allowing more time for teachers to engage students in 'higher-order learning objectives' (Dwyer *et al.* 1990 p6)	Students worked faster - productivity went up. For example, it was reported that children completed the entire maths syllabus in 60% of the time, while their scores remained similar with previous years. The quantity and quality of their writing also increased significantly. There were two impacts of this increased productivity on the teachers: "The extra time led to increased opportunities for teachers to engage students in higher-order learning objectives and problem solving in math." "outpouring of text overwhelmed ACOT's teachers and led to the need for new strategies for instruction, feedback, and evaluation." (Dwyer *et al.* 1990 p.6) Student engagement with schoolwork increased.
Appropriation	Roles shifted noticeably and new instructional patterns emerge – from teacher to facilitator – from didactic to constructivist.	The transition to this phase was dependent upon the level of teachers' personal 'mastery' of the technology. "Appropriation is the point at which an individual comes to understand technology and use it effortlessly as a tool to accomplish real work." (Dwyer *et al.* 1990 p.6) Key changes in this phase included major shifts in roles within the classrooms, accompanied by moves towards team teaching, interdisciplinary project-based work and individually paced instruction. The teachers began to recognize and value the students' expertise and noticed that the students themselves started to move towards more collaborative ways of working. The teachers started to make greater use of students to teach each other, and at the same time the teachers' role changed moved towards "becoming facilitators rather than dispensers of knowledge." (Dwyer *et al.* 1990 p.7). Another key characteristic of this phase "was an increasing tendency of ACOT's teachers to reflect on teaching, to question old patterns, to speculate about the causes behind changes they were seeing in their students." (Dwyer *et al.* 1990 p.8).
Invention	Purposeful radical change in 'classroom' practices	This phase was not reached within the ACOT work that is reported by Dwyer *et al.* (1990), but they identify that their teachers were beginning to be ready to think about purposeful educational change. The invention phase is thus "a placeholder for further development" (Dwyer *et al.* 1990 p.8).

Similarly, there were differences in the prevalent forms of computer use between primary schools in the USA and UK during the time that the ACOT research was taking place. These differences were epitomised by the predominance of computer labs in USA primary schools, which were almost totally absent from their UK counterparts. The norm in the UK was for computers to be distributed evenly throughout the classrooms within each primary school. Part of the reason for this difference related to an underpinning assumption that was evident within Dwyer *et al*.'s model; namely, that the traditional model of education in USA primary schools was highly didactic and based on behaviourist principles. Thus, Dwyer *et al*.'s model reflected the notion that using computers would lead to a change in pedagogy towards a more flexible, child centred approach based on constructivist principles. Indeed, the ACOT research from which this framework emerged, had as one of its primary targets the desire to "fundamentally change teaching and learning" (Dwyer *et al.* 1990 p.1) with "a decided bias towards a constructivist view of learning" (Dwyer *et al.* 1990 p.2). As a result the ACOT researchers "began actively educating and encouraging teachers to implement knowledge construction in their classrooms." (Dwyer *et al.* 1990 p.2).

Within County Primary school, which was chosen in part because it was typical of English primary schools, the underlying educational approach was somewhat different to that within the USA context. Whilst the predominant mode of teaching in County Primary school was didactic, this was moderated by notions of child centred education and constructivist theories of learning. This was, for example, reflected in the names of the maths groups in 5DS: Calculators, Investigators, Problem Solvers, Thinkers and Experimenters. In addition, all three case study classes engaged to some degree in interdisciplinary project-based work prior to the addition of the PowerBooks. For example, the children in 5DS always worked together in topic groups in the afternoon (Field Notes

23rd Nov), during which time they followed interdisciplinary themes. Furthermore, 2BH co-planned and team-taught with the adjoining class teacher on Wednesday mornings and for some aspects of the literacy curriculum. Thus, prior to the addition of any computer equipment there were facets of the educational practice within the three case study classrooms that most closely fitted the Appropriation stage within Dwyer *et al.*'s model, even where little computer use was taking place.

Analysing the computer use in the three case study classrooms using Dwyer *et al.*'s framework often resulted in confusion about which phase to locate the computer use in. Part of the reason for this may be these cultural differences between the USA and UK contexts. For example, in Period 1 much of the practice in the case study classrooms, as described in the previous paragraph, most closely fitted into the Appropriation phase. However, it was clear that for most of the time prior to the addition of the PowerBooks the other characteristics of the Appropriation phase did not apply. The most appropriate phase for 5DS and 4JJ during Period 1 would have been Entry, whilst the most appropriate phase for 2BH during Period 1 was Adoption. Thus the framework, perhaps because of cultural differences between the USA and UK contexts, suffered from an overlap between the stages, in the sense that the educational practice fitted criteria belonging to more than one phase.

As we have seen, the 5 phase model is underpinned by clear views of 'good practice', with movements from Entry to Invention being seen as progress or improvement. Thus the framework is value laden in the sense that certain forms of classroom practice are seen as being of higher quality than others. This might be encapsulated in a notion of moving away from didactic/behaviourist models to student centred/constructivist ones, and clearly means that the framework favours certain ways of using computers. This leaves it open to criticism by those who hold alternative views of effective educational practice.

In attempting to apply the framework to the three case studies it soon became clear that there was a mismatch between the time scale over which data was collected in Case Study 1 and the time scale that would have been needed to make full use of the framework. The framework is based on a notion of progression, and recognises that movements between different phases within the model are likely to take place over the course of years rather than weeks. For example, the criteria with Phases 2 (Adoption) and 3 (Adaptation) depend on having data that enables one to determine whether or not children's level of performance has changed from one year to the next in association with changes in computer use. These data was not available in the three case studies.

The notion of progression within the framework was also linked with notions of relative increases on some of the dimensions that were used to define each Phase within the model. For example, in the Adaptation phase the relative speed of children's work was important, but no absolute indicator of speed of working was provided. This raised questions about the extent to which it was appropriate to make comparisons across the case studies. Similar issues arose in terms of students' motivation and engagement with work. These problems became apparent early on in the process of using this framework to analyse the case studies. Despite this a fuller analysis of Case Study 1 was completed.

Description of the computer use in 5DS based on the 5 Phase Model

During Period 1 Mrs Smith made very little use of computers. However, it was clear that she had thought about the need to use them in her teaching, but lacked the knowledge to progress that further. Thus, for example, she expressed concern that as the Maths Co-ordinator she should be using IT because it was mentioned in the National Curriculum for Maths. However, she was unaware of any of the more common data handling programs available for the school's computers (e.g. Ourfacts) and did not know what a spreadsheet was (Mrs Smith, 23rd Nov). She also questioned the extent to which she could justify spending her time implementing IT when only a very few children would be able to do it at any one time and she could use the time in a way that impacted on a larger number of children (Mrs Smith, 23rd Nov). The low quantity of computer use in Period 1 suggested that Mrs Smith was operating within the Entry phase. However, talking to her suggested that the main focus of her attention was on how to use computers in her teaching and whether she could justify the time, rather than how to operate them. Her concerns thus most closely matched those described in the Adoption phase.

During Periods 2 and 3 it was clear that Mrs Smith's objective was for all the children to have experience using the software on the PowerBooks. She reported that all children would have had experience of word processing, painting, and drawing bar and pie charts by the end of Period 3, which she thought was "Pretty good given the amount of time!" (Field Notes 2nd Feb). This suggested that the computer use was at the Entry stage (Phase 1).

However, during this time Mrs Smith clearly recognised that the children were more competent at using the PowerBooks than she was:

> The kids know more about drawing than me …. I'm really impressed by how nice they were - I couldn't do it.
>
> (Mrs Smith, 7th Feb)

She started to capitalise on this by getting the children to teach each other how to use the software:

> They showed others ~~*showed*~~ *how* to use *the spreadsheet* software - one to one.
>
> (Mrs Smith, 7th Feb, text in italics inserted/deleted)

There was also a general move towards more collaborative ways of working. For example, when the children were writing their New Year Resolutions and drawing their Crusoe pictures they were working individually on the computers but shared ideas with others who were also using the computers at the same time. Mrs Smith showed the class the work as it was finished, which meant that

> the children who were last saw what others had done and so were more adventurous and had more idea of what to do.
>
> (Mrs Smith, 7th Feb)

Within the 5 Phase Model, recognition of the children's expertise and movements towards collaborative working fall within Phase 4 (Appropriation), and are associated with changes in roles. Whilst Mrs Smith was comfortable with, and indeed encouraged the children to support each other and share their expertise she still maintained tight control over the computer use. The most obvious form that this took was that the children had to seek permission before being allowed to print their work (Field notes 25th Jan). Mrs Smith commented that she didn't want children resetting computers - she wanted to do that sort of thing. (Mrs Smith, 7th Feb). This suggested that she was not operating at the Appropriation level. Indeed, there was no evidence of increasing student productivity during Periods 2 & 3, which suggested that they had not reached the Adaptation stage.

Mrs Smith seemed to have rapidly established how she wanted to organise the use of the PowerBooks. For example, she reported that initially she had had problems because the batteries only lasted 30 minutes or so, but that she had resolved this by only using four of the PowerBooks, which could then be plugged in whilst being used (Field notes 18th Jan). Thus, early on in Period 3 Mrs Smith appeared to have overcome the basic organisational issues involved in using the PowerBooks. This suggested that she had moved out of the Entry and into the Adoption stage.

During Period 4 there was little computer use. However, it was clear that Mrs Smith had arranged for a parent to work with a small group of children on one morning per week. This work seemed to fit most closely with the description of the Adoption phase. The use of the computer was integrated with the other classroom activities in a way that supported the traditional model of teaching within 5DS.

During Period 5 Mrs Smith's initial motivation for using the computers seemed to relate to the children's enthusiasm:

> Basically, they were around and my kids had had such a good time with them that I wanted to make extra use of them, if I could.
>
> (Mrs Smith, June)

This corresponds to the Adoption or Adaptation phase. Later in the interview Mrs Smith commented that the children's enthusiasm for using the PowerBooks had increased the their engagement with schoolwork, which falls within the Adaptation phase. This tied in with an increase in the children's productivity:

> Well, they certainly got more out of the time, they would have produced more in the time. … I mean, they'd reached the point, when we were using it before, that they were ready to start using them for written... to get their teeth in it and really start going for it, you know. Um... so when we started doing it again this time they were, they were ready for it and off they went.
>
> (Mrs Smith, June)

As had been the case in Periods 2 and 3, Mrs Smith recognised the children's expertise during Period 5:

> They also used... they also learned how to use the spellcheck which was wonderful, really good, and they became expert almost immediately.

And

> And they were very good at it. They were infinitely better than me.
>
> (Mrs Smith, June)

This again resulted in Mrs Smith using the children as peer tutors. Having noticed how good they were at doing this she started to actively work with the children, teaching them how to teach each other:

Researcher	Umm... but it's just, I mean, that's an interesting thing about noticing that they're actually effective at learning, you know, teaching each other. Because...
Mrs Smith	They are very good at it and we've had discussions about it and we've said that if you're a good teacher you wouldn't be touching the buttons. You would be ensuring that your pupil would be doing all the touching and you would be there as a safety net for that person. You wouldn't be telling them everything to do, you would be actually making sure that they can operate independently.
Researcher:	So you're actually starting to teach them how to teach? Which is even more interesting in lots of ways, isn't it?
Mrs Smith	Yes.

(Interview 15th June)

Thus, not only did Mrs Smith recognise and acknowledge the children's expertise in using the computers but also in teaching each other. Furthermore, in contrast with Periods 2 and 3, this time Mrs Smith seemed more comfortable with changes in the children's roles, as evidenced by the fact that she set up a system whereby her children would go to other classes to teach younger children how to use the computers:

Mrs Smith	Not every day, next year we're actually going to do that. We're actually going to have `Y', because I'm keeping this class, these will be my `Y6s' next year. We're actually going to schedule a programme where one or two of these children actually rota themselves into the computer work of the younger children.
Researcher	How's that come about? I mean, is that... what has stimulated that?
Mrs Smith	I guess, the fact that they were teaching each other so well on these.

(Interview15th June)

Alongside these changes, and the shift in focus from learning how to use the software to using it as a tool to enhance the children's learning in other areas, Mrs Smith seemed to have become more reflective and critical about the quality of the computer use. For example, she questioned the value of the spreadsheet use in Period 5:

Researcher	But in terms of actual quality....
Mrs Smith	It was... For the data stuff it was really just using the machine to represent it, so mathematically there wasn't a great... It wasn't sort of great. But it was interesting it did show up big areas of misunderstanding in the children. … so I wasn't actually there all the time but the bits that I did see, and the bits that I did discuss with the teacher and with some of the children, showed how they assumed because it looked OK that everything was all right. Whereas actually their categories had overlapped, or one might have been a sub-set of the other and they hadn't really understood that it was a problem. That was quite interesting.

(Interview 15th June)

This level of analysis spilled over into thinking more broadly about computer use in teaching. It was clear that Mrs Smith had gained an insight in to how computers could 'accomplish real work', in the sense of supporting learning in other areas, at least in the context of English:

Mrs Smith	Yeah. Once you reach the stage where the teachers are committed to doing it and feel that it's worthwhile then they will find their own solutions, more or less.
Researcher	Right. So, actually if you get the vision bit in place first, the understanding what it's about and seeing how it can be useful...
Mrs Smith	Seeing that it's worthwhile, seeing that it's actually going to do something that you can't do without it. Do you know what I mean?
Researcher	Right. And do you feel that now in terms of the language work?
Mrs Smith	Yes, definitely. The word processor can do much more for the kids than pencil and paper can. Yes.
Researcher	Right. If you hadn't had... I mean, you saw that because they were doing it or...
Mrs Smith	Well, I felt more convinced because I saw them do it. I mean, I probably wouldn't have argued about it to start with but I wasn't so determined..., I wasn't so committed to do it, to make it work, to try it. You know, I wasn't that committed....
Researcher	`Until I've seen it happen, I don't really believe it. Ummm... I'm not going to see it happen if I don't believe it because I'm not going to try it and... until I believe it.' Is that (laughter)...
Mrs Smith	Well I have to be, I have to be pretty convinced that it's worth trying because trying it is hard work and it takes a lot of time. So I have to be very convinced that it's worth it because it takes a lot of my time to do.

(Interview 15th June)

This all suggested that during Period 5 Mrs Smith was operating in the Appropriation phase. However, perhaps because of the cultural differences between the US and UK contexts identified earlier, there was little other evidence during this time of shifts in instructional patterns, which is identified as the main characteristic of the Appropriation phase.

During Period 6 Mrs Smith not surprisingly appeared to regress to an earlier stage within the 5 Phase Model. Her concerns seemed to be focussed on issues relating to familiarising herself with the computer and working out how to organise its use within her classroom:

> It's um... Because the Archimedes are new too, we're still at the stage really where we're becoming familiar with what software we've got, what our options are with it. I'm looking now at getting new software for the Archimedes, I'm trying to make better use of it.
>
> And
>
> The trouble is the Archimedes being just one computer, it's so much harder to organise. When you had six, seven laptops you could integrate it into a group activity and that group then could just justify taking your time. When you've got one child or two children working on the Archimedes you can't justify them having the same amount of time as the other 29...
>
> (Mrs Smith, 15th June)

Table 4.26 Summary of the analysis of Case Study 1 using the 5 Phase Model

Period	Phase within Model
1	Adoption
2	Adoption
3	Adoption
4	Adoption
5	Appropriation
6	Entry

Strengths and problems highlighted by the analysis of Case Study 1

This framework has an intuitive feel to it: the names of the Phases and their key categories seemed to fit. However, when trying to apply the framework to Case Study 1 a number of additional problems arose above and beyond those that have already been identified.

The first issue related to the impact that the quantity of computer use should have had on the categorisation made within the framework. There was no mention of the quantity of computer use within its definition, yet it would have seemed inappropriate to categorise the phase of development as being near the higher ends of the progression if the quantity of computer use was very low, or non-existent.

Secondly, the framework suffered from the problem of ambiguity; it was often unclear how to construe a particular criterion. For example, at what point should a judgement be made that an individual had come to understand the technology and used it effortlessly as a tool to accomplish real work? This criterion was open to widely differing interpretations. Linked to this was the overlap between the criteria for different phases, which in turn related to the notion of discreteness, raised in relation to the Software Frameworks. It was often unclear which phase to categorise the computer use as belonging to, given that it appeared to satisfy criteria from more than one Phase. No guidelines on how to apply the model in order to overcome this problem were provided.

Despite the fact that applying the Five Phase Model was difficult and time consuming, it failed to provide descriptions of the computer use in different Periods of Case Study 1 which discriminated adequately between them. Table 4.26 provides a summary of the descriptions of each Period, based on the Five Phase Model, in which it looks as if Periods 1 to 4 were very similar. This was not the case. This reflected a lack of richness in the top level descriptions of the practice provided by this framework.

Sandholtz *et al.*'s (1990) Teachers' concerns framework

Sandholtz *et al*. (1990) were concerned with "the evolution of classroom management in ACOT's high-tech classrooms." (p.2). Their model was based on Fuller (1969) and Hall & Louck's (1979) three stage model of teacher development, which they concluded could be applied in the context of computer use, on the basis of an analysis of 13,000 learning 'episodes' from the ACOT schools. Their framework, which is summarised in Table 4.27, identified three stages through which teachers progress in their use of computers. Sandholtz *et al.* made it clear that in applying this model, it was important to bear in mind that the stages are not clear cut or strictly sequential; teachers may 'regress' temporarily when new equipment or students are introduced.

Given that both this framework and Dwyer *et al.*'s Five Phase Model emerged from the ACOT research it is not surprising that there are many similarities between them. For example, they share the same underpinned set of values about the most effective ways to teach. Thus, the Teacher's Concerns Framework indicated that in moving from Stage 1 to Stage 2 there will be a shift from focusing on end products of learning and towards learning processes. Given that the model claimed to represent progression in the use of computers this suggests that this shift in pedagogical focus is necessarily associated with advances in computer use (from Survival to Mastery). As before, this impacted on the analysis of the case study classes, which already viewed educational processes as being of great importance:

> Mrs Smith said that marking was very time consuming and that she did not always feel it was valuable. She talked about the process being more important than the final product but concluded by saying, 'but our parents expect it to be marked'.
> (Mrs Smith, 7th Feb)

This problem of cultural difference between the USA and the UK appeared to be less significant for the Teachers' concerns framework than to the Five Phase Model. This was probably due to the fact that it made fewer explicit demands on the underpinning view of education than Dwyer *et al.*'s Five Phase Model. The latter used notions of shifts from didactic to constructivist teaching as one of the main dimensions, whilst the Sandholtz *et al.*'s framework only included this as a small part of the definition of each of its stages.

Table 4.27 Description of Sandholtz *et al.*'s Teacher's concerns framework

Stage	Description
1 Survival	**Main feature: Teachers' inability to anticipate problems** Four main types of problem: **Student misbehavior and attitudes**, which include: new types of misbehaviors relating to hardware and software (e.g. copying software, sabotage); new ways to 'cheat' (e.g. plagiarism and hacking into CMA systems); new excuses for not doing work (e.g. homework not completed because the computer crashed at home); students resisting the teacher's directions (e.g. wanting to use the computers when the teacher wanted them to do something else). **Physical environment issues**, which can be related to: facets of 'traditional' classroom design (e.g. classrooms becoming more crowded and more cluttered; problems relating to lighting and glare); and 'external' environmental issues (e.g. overheating, 'floods'). **Technical problems**, which included: equipment not arriving on time; breakdowns; bottlenecks (e.g. at printers); as well as issues of software 'maintenance' and management. Technical problems were the most commonly reported type of difficulty and "upset both their daily and long-range plans." (Sandholtz *et al.* 1990 p.5). **Classroom dynamics**, which related to changes in aspects of classroom practice such as: an increase in noise level; increased pupil movement around the classrooms; children knowing more than teachers about how to operate the technology (and hence changes in roles).
2 Mastery	**Main feature: Teachers anticipate and develop strategies to solve problems** A key feature of this was the way in which teachers, as they increased their technical competence, started to share their skills with other teachers to a greater degree. Their increasing technical knowledge also: "had a noticeable impact on student engagement," and "strengthened their instruction as well as their classroom management. Teachers began to envision long-term instructional goals that focused on successful problem solving and conceptual understanding rather than specific content." (Sandholtz *et al.* 1990 p.6). It would appear that teachers within this stage of the model were changing their views about their role. They seemed to move towards a more problem based/learner centred model with the teacher as facilitator and the educational goals being to do with process more than product (developing skills rather than remembering facts). As part of this re-orientation teachers became less concerned about issues relating to things such as the free movement of children around the class and the noise level.
3 Impact	**Main feature: Teachers use technology "to their advantage in managing the classroom"** (Sandholtz *et al.* 1990 p.7) "teachers discovered the technology could save time rather than create additional demands." (Sandholtz *et al.* 1990 p.7) Initially this seemed to develop in terms of efficiency gains in the teachers' preparation, marking and administration (e.g. record keeping, preparation of materials, automating marking). It then moved into instructional areas. For example, some maths teachers reported that they "could reduce class time spent on practicing arithmetic skills by relying on computer homework; this freed class time for developing problem solving skills." (Sandholtz *et al.* 1990 p.7). Within this stage teachers clearly rethought their role, and in so doing started to make use of the children's expertise, both as peer tutors and to do work that the teacher would otherwise have needed to do (e.g. solving technical problems the teacher couldn't solve). By drawing on the children's expertise the teachers freed up their own time which "made it possible to provide more individual help to those who were experiencing difficulties." (Sandholtz *et al.* 1990 p.7). The management strategies moved towards a learner centered model. These changes in the teachers were accompanied by increasing levels of pupil interest and attention. One of the indicators of teachers having reached this stage was that they stopped worrying about having the technology and started to worry about how they would cope if they did not have the technology, as illustrated by this quote from the research data: "It would be hard to live without a computer ... It has become a way of life." (Sandholtz *et al.* 1990 p.7)

Description of the computer use in 5DS based on the Teachers' Concerns Framework

During Period 1 Mrs Smith reported that the main problem with using computers in schools was the technical problems relating to unreliability of the equipment (Mrs Smith, 9th Nov). This was reflected in the very low level of computer use in 5DS during this time. This fell within the Survival Stage, with the main issue being technical problems.

During Periods 2 and 3 a good deal of Mrs Smith's time was taken up with sorting out problems. These related to:

'student misbehaviours':

> Because of the nature of the children its difficult to control - they sneak in and out and try to have a fiddle.
>
> (Mrs Smith, 7th Feb)

Physical environment issues:

> I mean, the first time we did it, we were all over the dog [place]. I think we had two over there, two over there and we had leads everywhere. It was a nightmare.
>
> (Mrs Smith, 15th June)

Technical problems:

> Mrs Smith commented that one of the pins on the printer cable had bent and she had bent it back.
>
> (Field Notes 12th Jan)

Classroom dynamics:

> When using computers you need someone about who can help you immediately. If there's a problem you need to sort it then and there you can't put it to one side and sort it later like a maths book.
>
> (Mrs Smith, 7th Feb)

> I needed to be there at the start and end of sessions to sort out problems, like to make sure they were plugged in or the battery was OK, or to sort printing,
>
> (Mrs Smith, 7th Feb)

This suggested that the computer use in Periods 2 and 3 was at the Survival Stage. However, Mrs Smith appeared unconcerned that the children were more expert in using the PowerBooks than she was, which fitted better with Mastery or even Impact. This tied in with her use of children to solve problems and act as peer tutors (Mrs Smith, 7th Feb), which again fitted the Impact Stage. However, despite this, Mrs Smith acted in her predominant role, by controlling what the children were allowed to do. For example, she did not allow them to print out without first obtaining her permission (Field notes 25th Jan). Overall the computer use in 5DS seemed to move from Survival to Mastery during Periods 2 and 3.

During Period 4 there was little evidence available to inform a categorisation of the computer use in 5DS. However, discussions with Mrs Smith about the computers she had available during this Period (i.e. the BBC and A3000, which she referred to as the Archimedes) suggested that her focus was on coping with problems. Limitations with the equipment were also evident. For example, The BBC remained outside the classroom and unused for the entirity of Periods 1 to 6, due to Mrs Smith's perceptions that it was technically unreliable (Field Notes 25th Jan). The A3000 was also located outside the classroom, because it was (at least in theory) shared between three classes. Mrs Smith also noted that having just one computer (i.e. the A3000) made it difficult to organise the use of the computer and difficult to justify her time working with it (Mrs Smith, 15th June). This all reflected features of Stage 1 within the Teachers' concerns framework. However, Mrs Smith was keen to harness the children's motivation for using the computers:

> The kids got... The kids loved it so much, that has to be a factor really. They were so motivated to use them and that's got to be worth harnessing really if they... if they can apply the same motivation with that to the Archimedes and to the other computers.
>
> (Mrs Smith, 15th June)

and she had started to tackle the organisational issues by using a parent to work with the children on the A3000:

Mrs Smith	Well, I've also made an organisational step as well in getting a parent to do it.
Researcher	Right.
Mrs Smith	But then again, I mean, that still speaks of the confidence I have in it because I could be using the parent to do something else. And she is a very good parent who I trust implicitly to do loads of things and yet I'm asking her to do that.

(Interview 15th June)

Here she was at least starting to move towards Stage 2 of the model.

During Period 5, it was clear that Mrs Smith was still spending a good deal of her time sorting out problems, which suggested that computer use was at the Survival stage. For example on the 20th May two children from 5DS had been into the CPU configure menu and altered the password and other system settings. Mrs Smith was unable to solve this 'misbehaviour' and commented that she would have to monitor their wanderings (around the desktop) more carefully so that this sort of thing did not happen again (Mrs Smith, 20th May). However, it was also apparent that she had overcome the day to day organisational problems with using the PowerBooks:

Researcher	Was it, was it easier the second time around from your point of view, I mean, because I remember the first time round you, it was taking a lot of your time and...
Mrs Smith	The first time round it was a headache simply organising it..., the power points for instance. … So just on a, on a sort of a practical, mundane level, yes, it was much better. Um... It was also easier the second time around because it wasn't such an extreme novelty that every body was watching it every minute, you know...

(Interview 15th June)

Even so, computer use was still taking a great deal of Mrs Smith's time:

Mrs Smith	Even when it's going well, they still demand a lot of time because inevitably somebody touches something and something unexpected happens and however good these kids are, and they are very, very good at it, they can't always identify whether they've got a serious problem on their hands or whether it's just something that's going to get better in a minute.
Researcher	Yeah.
Mrs Smith	So they still need me to actually say `Is this is a serious problem or not?'

(Interview 15th June)

Evidence that 5DS had progressed past Stage 1 came from the impact that the computer use was evidently having on the children's engagement with learning:

Researcher	What were the most positive aspects of having the equipment?
Mrs Smith	I guess, motivation has to be top of the list. The kids were so keen to use them, so they were then more open and receptive to doing the learning, which they didn't realise they were doing, but which I was wanting them to do,

(Interview 15th June)

Mrs Smith was also gaining in competence and had started to share her experience of using the PowerBooks with the teachers in the other case study classes to help them make better use of them (Mrs Smith, 15th June). This illustrated the generally raising profile of IT throughout the school:

Researcher	I mean, you say it's quite high profile and you're discussing it, what forums, I mean, is that formally in staff meetings or is that just something that...
Mrs Smith	We haven't... we haven't got to doing it formally but it's something that is at the front of our minds, put it like that. It's something that we are discussing informally, it's something that's not very deep down and hidden away.

(Interview 15th June)

The extent to which 5DS had progressed past Stage 1 was also evident from the way in which Mrs Smith was making use of the children's expertise, both to solve problems as they arose and to teach other children, both inside 5DS and around the school, how to use computers.

Mrs Smith	Which is what is happening now. My children are helping Brenda's.

(Mrs Smith, 15th June)

In response to the initial questionnaire Mrs Smith had indicated that she did not want to use computers for administrative tasks. By the end of Period 5 she had bought herself a computer for use at home, which she was starting to use to support her administration and preparation:

Mrs Smith	And if that, I mean, I'm already beginning to do that....
Researcher	There are all sort of organisational things....
Mrs Smith	at home now a bit more now. We've just got a computer at home now and I'm using it. I'm just beginning to start using it really. I mean, that's really nice to be able to do work sheets at home and know that they look nice and to actually get it..., but it takes quite a while to become familiar with that because you've got so limited time in order to build up that familiarity.

(Interview 15th June)

Overall 5DS seemed to be moving from the Mastery to the Impact level, although there was no clear evidence that Mrs Smith had reached the point where she would not know how to cope if 5DS did not have access to the technology.

During Period 6, the computer use was very similar to that within Period 4. Despite the passage of time there was no evidence to suggest that 5DS' use of the A3000 had progressed since then. Thus they were operating somewhere between the Survival and Mastery Stages during Period 6.

Table 4.28 Summary of the analysis of Case Study 1 using the Teachers' Concerns Framework

Period	Stage within the Framework
1	Survival
2	Moved from Survival
3	to Mastery
4	Survival
5	Mastery – with some evidence of Impact
6	Survival

Strengths and weaknesses of the Teachers' Concerns Framework emerging from the analysis of Case Study 1

The preceding analysis of Case Study 1 on the basis of the Teachers' Concerns Framework highlighted that this framework suffered from very similar strengths and weaknesses to Dwyer *et al.*'s Five Phase Model. Thus, the framework had an intuitive feel to it, but, in attempting to apply it, a range of problems became evident.

There was a lack of clarity in the definitions of each of its Stages and for most of the Periods within Case Study 1 there was evidence suggesting that the computer use spanned more than one Stage. This was partly due to ambiguity in the definition of the criteria; for example, one of the criteria for Stage 2 was that computer use was having 'a noticeable impact on student engagement', but what this should actually have looked like in practice was not specified. Furthermore, the Stages were not discrete, in the sense that the computer use at any one time could satisfy criteria in more than one Stage.

Interestingly, and in contrast with Dwyer *et al.*'s model, the high level descriptions of the computer use in 5DS resulting from the application of the Teachers' Concerns Framework did provide a more accurate comparison of the ways in which the use changed. However, the original analysis of 4JJ using this framework suggested that it did not discriminate well in that case (see Table 4.29). The key reason appeared to be the lack of any mention of the quantity of use within the framework.

Table 4.29 Summary of the initial analysis of Case Study 2 using the Teachers' Concerns Framework

Period	Stage within the Framework
1	Survival
2	Survival
3	Survival
4	Survival

Summary of the criteria for evaluating computer use frameworks

By applying a number of different types of frameworks to the three case studies a number of strengths and weaknesses with such frameworks were identified. These can be viewed as criteria against which any computer use framework can be evaluated. Table 4.30 sets out the criteria, along with their defining questions, and information about which of the three main categories of frameworks they emerged from. (Within this Table S represents Software Frameworks, P represents Pedagogical Frameworks and E represents Evolutionary Frameworks)

Table 4.30 Criteria for evaluating frameworks for describing and thinking about computer use in education

Label	Defining question	S	P	E
Accuracy	Does the framework provide accurate and consistent descriptions of computer use?		✓	✓
Adequacy	Does the scope of the framework cover all possible cases/types of computer use?	✓		✓
Ambiguity	Are all the dimensions of the framework fully and clearly defined?	✓	✓	✓
Contextualisation	Does the framework look at computer use in context (i.e. the practice surrounding computer use)?	✓		
Cultural specificity	Is the framework based on expectations of educational practice that are culturally specific?			✓
Currency	Will the framework date as the technology changes?	✓		
Discreteness	Are the dimensions of the framework orthogonal (discrete in the sense of not overlapping)?	✓		✓
Discrimination	Does the framework provide a sufficiently rich picture to enable discrimination between contexts?	✓		✓
Ease of use	Is it easy to apply the framework?		✓	✓
Generativity	Does the framework help to inform thinking and thus lead to richer descriptions of practice?		✓	
Guidelines	Are guidelines provided explaining how to apply the framework?			✓
Internal consistency	Are the definitions of the dimensions of the framework internally consistent?	✓		
Intuitiveness	Does the framework (and its dimensions) seem right – have an intuitive feel to it (them)?	✓		✓
Overlap	Can the same practice fit criteria in more than one position on a dimension?			✓
Quantity of use	Does the framework take into account the quantity of computer use?			✓
Relativity	Does the framework rely on relative measures, which may be interpreted differently in different contexts?			✓
Simplicity	Does the framework have a small number of dimensions? Does each of the dimensions (or sub-dimensions) add clarity or richness to the description?		✓	
Value laden	Does the framework enshrine implicit or explicit views of the quality of the practice being described?	✓	✓	✓
Wholeness	Are the dimensions explicitly linked together in a way that provides one holistic picture?		✓	

Identifying these criteria represented the completion of Action Step 2 within Cycle 1 (Table 2.8 p.65). None of the existing frameworks met all, or indeed most of these criteria.

The research thus moved on to Action Step 3 within Cycle 1: the creation of a better framework for describing computer use, as a first step to overcoming the problem of the lack of impact of investments in ICT. The development of the initial version of the Computer Practice Framework (CPF), as it was called, is described in the next chapter.

Chapter 6
Refining the Computer Practice Framework

Introduction

In the previous chapter the development and initial evaluation of the CPF, using the criteria identified in Chapter 4, were described. This completed the first 'action research cycle' as identified in Table 2.8 (p.61). It was clear that further evaluation of the CPF was required and that this needed to include further fieldwork. To that end another set of case studies were planned (Cycle 2 Action Step 1 – see Table 2.8). It was clear that this would not provide sufficient evidence about the CPF in relation to the criteria relating to *cultural specificity*. To overcome this plans were also put in place to investigate the CPF in the context of UK higher education (Cycle 2 Action Step 2 – see Table 2.8). This chapter describes the first two additional case studies (Case Studies 4 and 5) and the use of the CPF in UK higher education, including providing an account of the modifications that were made to the CPF in the light of this fieldwork (Cycle 2 Monitoring and Revising General Ideas – see Table 2.8).

The additional case studies

The methodological rationale for the use of case studies and the data collection techniques used were discussed in Chapter 2. The plan included carrying out three studies, as shown in Table 6.1. This design was intended to enable comparisons to be made between different contexts (e.g. Mrs Light in 1998 and Mrs Henry in 1998). Case Studies 4 and 5 are reported in this chapter. Case Study 6 is the focus of the next chapter.

Table 6.1 The Plan for the additional case studies

	1998	2000
Mrs Light	Case Study 4 (Year 5)	Case Study 6 (Year unknown)
Mrs Henry	Case Study 5 (Year 6)	

In order to maximise the attractiveness of the research to potential schools and as a direct stimulus to change practice relating to computer use over the period of investigation (2 years) the research design included the provision of additional computer equipment to the case study classes. This had the effect of limiting the research to one school, as the funding was not available to provide more than one set of additional equipment. The initial case studies had provided evidence to support the view that sharing sets of portable computers was practical, in that any one class was unlikely to use it all, or even most of the time. Thus the research design was based on the notion of two classes in one school sharing an additional set of portable equipment. The decision about what equipment to provide was delayed until after the school had been identified, in order to tailor the equipment to the needs of the school. Due to delays in delivery and security marking the equipment it was not used until after case studies 4 & 5 had been completed.

The criteria used for selecting the second case study school were the same as those used in selecting County School. Brookdale Combined School was selected as best fitting the criteria and the schedule for Case Studies 4 and 5 was agreed (see Table 6.2).

Table 6.2 Schedule for Case Studies 4 and 5

Period of time (Wk beginning)	**Data collection**
6th Jan 1998[1]	Spring Term Starts
6th Jan	Plans and background documentation Manual Logs (Appendix C)
12th Jan	Medium term plans Manual Logs
19th Jan	Non-participant observation Teacher interviews Weekly/daily plans Manual Logs
6th Feb	Teachers' questionnaire (Appendix D)
23rd Feb	OFSTED inspection - the OFSTED report provided additional contextual information about the school

[1] This was the first week of the Spring term and the school was closed on Monday 5th Jan.

Background information was collected in order to provide a picture of the context in which the case studies were taking place. This included analysis of: school documents, such as the school prospectus, policy documents and the OFSTED report for the inspection that took place a month after the main data collection; and the IT co-ordinator's responses to a questionnaire that asked for details about the school, particularly in relation to their ICT provision (see Appendix E).

The main focus of the data collection was on the educational practice surrounding computer use. As much data as possible were collected about these educational practices, using the same methods as for the first three case studies (see pp.58-59), with a number of important changes. The use of automatic logging software was not possible but Manual Logs were still used, though they were modified to reflect the dimensions of the CPF (see Appendix C). More importantly, participant observation was replaced by non-participant observation in order to allow the researcher to keep a running record of any activity within the classroom[2]. The use of non-participant observation was appropriate as the key research question related to the extent to which the CPF met the criteria for describing computer use, set out in the previous chapter, without trying to understand or explain the underlying assumptions and causes of that practice. Thus it was less important for the researcher to become embedded within the classroom culture than had been the case for the initial three case studies. Indeed, using non-participant observation allowed the researcher to maintain a degree of detachment from the activities within the classroom and to collect detailed data about the classroom practice as it occurred, rather than having to depend upon recall of that practice after the event. This included taking photographs and conducting informal interviews with children in the classroom as they were working as well as with the class

[2] Classroom is taken to include any areas in which the children were learning, including shared areas outside the classroom.

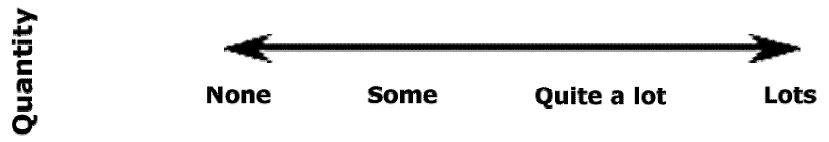
teachers during non-teaching times. In addition to these informal interviews the researcher interviewed each of the case study teachers, using a semi-structured approach, on at least one occasion after the main period of classroom observation. The case study teachers also each completed a questionnaire that asked for information about a wide range of dimensions of their practice as it related to computer use. This included asking the teachers to rate their computer use against the dimensions of the CPF, as well as on a wide range of other dimensions (see Appendix D).

As had been the case with the previous case studies the case study teachers were provided with copies of all of the non-participant observation notes, photographs and transcripts so that they could comment on them or veto their use, except where this might compromise an individual child's right to confidentiality. Mrs Light commented that she was impressed by how objective the researcher had been in his observations (Mrs Light, 30th Jan).

Modifications to the Computer Practice Framework

In the process of designing the questionnaires for use in Case Studies 4 and 5 a significant change was made to the CPF. In the previous chapter the way in which the categories on the Focus and Mode dimensions was decided were different (see p.220 and p.225 respectively). The category on the Focus dimension that applied was the one which was most prevalent, whilst the category on the Mode dimension that applied was the one that was furthest from the 'None' end of the dimension. In order to make the way in which the CPF was applied more consistent and to provide more information about the pattern of computer use this was altered. For both the Focus and Mode dimensions the respondent had to specify the extent to which each category on that dimension applied, using the fuzzy descriptors 'None', 'Some', 'Quite a Lot', and 'Lots' (see Figure 6.1).

Figure 6.1 Representation of the changes to the CPF (v4)



Focus	**Pragmatic**	None	Some	Quite a lot	Lots
	Computing	None	Some	Quite a lot	Lots
	Learning	None	Some	Quite a lot	Lots

Mode	**Repetition**	None	Some	Quite a lot	Lots
	Replacement	None	Some	Quite a lot	Lots
	Extension	None	Some	Quite a lot	Lots

The respondents were then asked to specify what they considered the range of reasonable interpretations for each of those fuzzy descriptors to be. For the Quantity dimension this was in terms of the number of minutes per day (See Question 5 in the questionnaires in Appendix D for more details). For the Focus and Mode it was in terms of the relative percentage to which each category applied (See Questions 7 and 9 on the questionnaires in Appendix D for more details).

Data analysis

The data from Case Studies 4 and 5 were analysed in two ways in order to produce two different descriptions of the practice in each class. One description consisted of a rich account of the computer use in terms of a range of key dimensions of practice (see Table 6.3). The other was based on the CPF.

Table 6.3 Key dimensions of practice used to structure rich descriptions of computer use in Case Studies 4 and 5

Dimension	Brief description
Space	The quantity and quality of space allocated to computers within the class.
Overview of computer use	Description of what they used the computers for.
Quantity	The amount of computer use.
Planning and the curriculum	How class time was scheduled or timetabled and how much time the teacher spent on planning computer related activities. The extent to which computers impacted on the content of the curriculum as a whole and/or on children's progression through the curriculum. The audiences that they targeted their work towards when working on computer related activities.
Roles	How much time the teacher and/or other adults spent on preparing and supporting computer related activities. The extent to which the teacher and/or children had control over aspects of the computer related work the children did. The view of teacher fallibility the teacher tried to maintain and the human sources of expertise children used in computer related activities. The nature of the questions that the teacher asked her children in the context of computer related activities.
Organisation	The relative occurrence of different sizes of groupings for computer related activities. The criteria used for deciding on the composition of groups for computer related activities. The ways in which children worked for computer related activities (i.e. Individual, parallel, co-operative, collaborative).
Recording	How much time the teacher spent on recording pupils' progress on computer related activities

In analysing the practice surrounding computer use against the CPF three different sets of figures were produced: the researcher's holistic judgement about the overall pattern of computer use; the class teacher's holistic judgement about the overall pattern of computer use; and an holistic judgement based on an analysis of each activity that the researcher observed in relation to the CPF.

In completing the analyses of the descriptions of computer use based on the CPF it became clear that providing information about the interpretation that was placed on the use of the fuzzy terms was valuable. Indeed, when it came to attempting to amalgamate the data across a range of different computer activities the percentages proved essential. Thus, in reporting the analyses of the computer use against the CPF the fuzzy descriptors percentages or percentage range are included. In the case of the Quantity of computer use this figure represented the percentage of the available teaching time during which computers were in use. For the Focus and Mode the figures represented the percentage to which each category applied (relative to the other categories on that dimension). The outcomes of Case Studies 4 and 5 were then compared, using the evaluation criteria identified in Chapter 4 (see Table 4.30).

Overview of Case Studies 4 and 5

Description of the case study school

Brookdale was a two-form entry county combined school. Thus there were approximately 60 children in each year group. As with all schools in the LEA children started school in the term in which they were 5 and left for secondary school at the end of Year 7. The school was built in 1988. It was a single story building, which housed 16 'home bases' built around shared areas. The school building was divided into two sections, with the staff room, offices, music room and hall in the middle. Rising Fives through to Year 3 occupied one section of the building with Years 4 to 7 in the other section. The school was situated in spacious grounds, including two tarmac playgrounds and a playing field.

At the start of Case Studies 4 and 5 there were 17 teachers and 8 teaching support staff. The head teacher took up his post in 1995. The IT co-ordinator, who was also the teacher in Case Study 5, reported (Questionnaire Dec '97 – see Appendix E) that the majority of the teaching staff had had at least one day IT INSET. Few staff had had much more than this, and none of them had completed any certificated IT INSET. The IT co-ordinator indicated that there were not many staff in the school who were confident about using computers per se or about their ability to manage and organise their children's use of computers. This contrasted with the IT co-ordinator's judgement that the staff as a whole were quite experienced and had quite a lot of confidence about their ability to manage their classes in general. The school's IT policy was in place, and five of the policies for other curriculum areas (English, Maths, Science, History, Geography) made explicit, if fleeting mention of IT.

During the year preceding Case Studies 4 and 5 the school spent approximately £1000 on 'curricular IT' (i.e. excluding expenditure on administration systems). The development of pupils' access to information technology and the staff's IT knowledge and skills were identified as targets in the school's development plan in 1997-98. £500 was earmarked for IT INSET to support this objective. This linked in with the IT co-ordinator's statement that the school wanted to take part in this research "To help us further develop our use of IT in the classroom." (Questionnaire Dec '97).

Prior to the addition of the equipment provided by the researcher the school had 21 computers (6 BBCs, 12 Archimedes, 1 RISC PC, 3 PCs) plus 21 Psion PocketBooks. This included three computers for admin purposes (a PC in the head's office and two PCs in the secretaries' office), one for each class and the rest shared around the school. The PocketBooks were kept in a secure cupboard and could be booked out by teachers.

Case Study 4

The Case Study 4 class (5SL) was a Year 5 class (9 - 10 year olds) of 31 (16 girls and 15 boys). The class teacher (Mrs Light) had been teaching for approximately 10 years. She held the post of responsibility for Drama within the school.

During the Spring Term, when Case Study 4 took place, 5SL had access to one Acorn computer in the classroom and approximately 20 Psion PocketBooks, shared across the whole school and stored in the secure central stock cupboard. They also had occasional access to two computers outside the Y7 class.

Rich description of the practice surrounding computer use

The space allocated for computer use

As can be seen from Photograph 6.1, 5SL was an airy room that opened out onto an area that was shared with a number of other later years classes. The opening between the shared area and the classroom could be shut off with a curtain (Photograph 6.2).

Photograph 6.1 5SL, looking in from the shared area

Photograph 6.2 Looking out from 5SL into the shared area and the entrance to another classroom

5SL's computer was housed on a computer trolley at the back of the classroom (see Photograph 6.3). Whilst Mrs Light thought that this was a high quality space in terms of being pleasant to work in (Questionnaire 6th Feb), Photograph 6.3 shows that the trolley was rather cramped, with little room for resources other then the computer hardware itself.

Photograph 6.3 The Acorn computer inside 5SL

When the school set of PocketBooks were in use their box was generally placed on the floor next to the class' computer trolley. Each of the PocketBooks was numbered so that children could locate the same one as they had used previously, in case they needed to carry on with work that was stored on that machine. Children would come to the box and search for the PocketBook that they had used last time. They would then take it back to their place to do their work.

Overview of computer use

During the first half of the Spring term the use of computers in 5SL appeared to fall into two main types: using an adventure game (Crystal Rainforest), which linked in with their 'Saving the Rainforests' theme for the half term; or using 'generic tools', including: a simple data handling program (Graphplot); a painting program (First Paint); and two word processing programs (Write on the PocketBooks and Pendown on their classroom computer). They also connected the Pocketbooks to their class computer (an Acorn) in order to transfer work between them.

The quantity of computer use

In the questionnaire at the end of January, Mrs Light estimated that children in her class used computers for an average of 120 minutes per day (Question 1). However, in response to Question 2, which asked her to calculate the average computer use per day taking into account the number of computers used, she estimated this as being 60 minutes per day. Her medium term plans for the Spring term included specific mention of IT under English, Geography and IT. As can be seen from Table 6.4, which reproduces the relevant entries from these plans, these plans did indicate that a significant number of computer activities were planned.

Table 6.4 Summary of IT related entries in Medium Term Plans for 5SL in the Spring term 1998

Subject	Summary of entries containing references to IT
English	**Activities** PARTS OF STORIES (WITH DRAFTING PARTNER) 1. Beginnings – revise what is the beginning of a story eg who/what/when/where Using a picture for stimulus write only the beginning of a story. Drafted by partner, written in best on PocketBook. 2. Middle – revise requirements for the middle of a story – moving on, development of characterisation, plot, situation, problems. Write only the middle of a story from an object used as a stimulus. Drafted by partner, written in best on PocketBooks. 3. End – revise endings – conclusions, resolutions, drawing together of plot/characters, surprise endings … Stimulus Precis the beginning and middle of a story leaving the children to write the ending. Drafted by partner written in best on pocketbooks.
Geography Community link (Midland Bank / Abbey Cakes)	**Objectives** To develop all cross curricular links with the setting up of a small business - Mathematics, English, Geography, Art and Design, IT.
Information Technology	**Activities** PocketBooks:- To use these weekly to develop word-processing skills - creative writing. Crystal Rainforest:- Children to develop problem solving skills. Magpie:- Children in small groups will put together simple presentation on Rainforest (max three categories).' 1st Paint:- To design logo for business (badges labels etc) Pendown:- To be used as a tool to enhance PocketBook work. Pinpoint (Junior):- To be used to generate questionnaires and then draw conclusions from data collected. Graphs etc. - linked to business venture.

5SL's weekly timetable also identified 'IT PocketBooks (stories)' as occupying half of the Wednesday morning slot between break and lunch (shared with PE). Mrs Light confirmed (Mrs Light, 19th Jan) that she operated a two week cycle, with the PocketBooks being used during this 75 minute slot one week and PE occupying the slot the next week. This corresponded with the reference to the PocketBooks in the medium term plans for English and IT (Table 6.4). A group of 5 boys from 5SL also confirmed that they had been using the PocketBooks on Wednesday mornings since the start of term (Mrs Light, 19th Jan).

The Manual Logs indicated that computers were in use for approximately 50 minutes per day over the 19 school days for which the logs were completed. The researcher's observations over five days of that same period corroborated this figure. A number of children also provided evidence to support the view that computers were used on a regular basis, as illustrated by this extract from a transcript of an informal interview:

Researcher	Let's ask you Mick, how have you used the computer so far? Did you use it last week?
Mick	Um, no.
4 other children in Mick's group	Yes we did!
Alex	We used it for about an hour.
Mick	Oh yeah, we used it to get some pictures, like of some animals …
Researcher	What, from a CD-ROM?
Boys	Yeah.
Researcher	Oh, right, so where's the CD-ROM machine?
Mick	In Year 7's room.

(Interview 19th Jan)

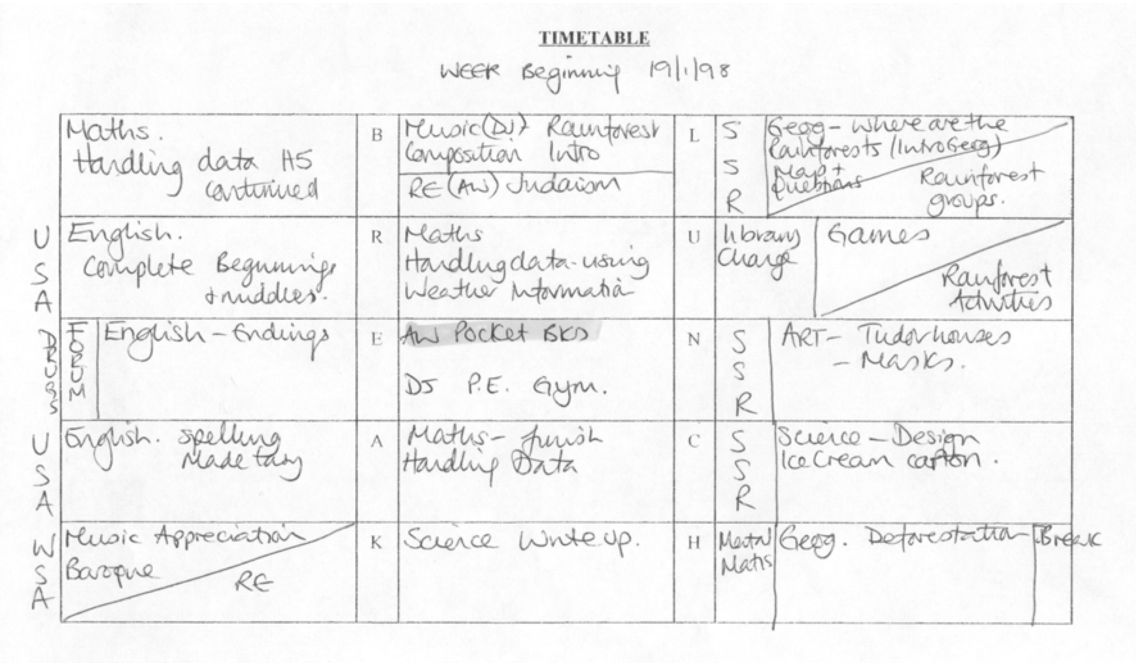
Indeed, this suggested that the children had been using the computer for an additional activity that was not mentioned in Mrs Light's planning and which involved using a computer in another part of the school.

Overall Mrs Light's estimates of the amount of time that 5SL spent using computers appeared to be high, particularly as the Manual Logs suggested that the level of use during the period the researcher was present was higher than the norm. It seemed reasonable, on the basis of this evidence, to conclude that the quantity of computer use in 5SL was slightly less than 50 minutes per day on average during the first half of the spring term.

Planning and the curriculum

Mrs Light said she spent an average of 12 hours per term planning for computer related activities (Questionnaire 6th Feb). This was not reflected in her written plans, although it is possible that she spent more time thinking about what she intended to do than her planning entries reflected. The fact that she said that her planning time was spread throughout the term in regular sessions supported this view, as her weekly plans were very brief, as illustrated in Figure 6.2.

Figure 6.2 Example of one of Mrs Light's weekly plans



TIMETABLE

Week Beginning 19/1/98

	Maths. Handling data H5 continued	B	Music (DJ) Rainforest Composition Intro / RE (AW) Judaism	L	S S R	Geog - Where are the Rainforests (Intro Geog) Map + questions / Rainforest groups.
U S A	English. Complete beginnings + middles.	R	Maths Handling data - using Weather Information	U	library change	Games / Rainforest Activities
[illegible]	FOCUM English - Endings	E	AW Pocket Bks / DS P.E. Gym.	N	S S R	ART - Tudor houses - Masks.
U S A	English. Spelling Made Easy	A	Maths - finish Handling Data	C	S S R	Science - Design Ice Cream carton.
W S A	Music Appreciation Baroque / RE	K	Science Write up.	H	Mental Maths	Geog. Deforestation / Break

The weekly plans suggested that the use of computers was restricted to specific time slots each week. However, it was clear from the researcher's observations and the Manual Logs that there were times when the computer was used that were identified on the weekly timetable as being another subject. Mrs Light confirmed that it was the case that she had specific IT slots (on alternate Wednesday mornings) and also subsumed IT within other subjects (Questionnaire 6th Feb). Indeed there appeared to be quite a lot of flexibility about when computers were used. Whilst there were generally identified start and end times for computer activities the children were often allowed to carry on with a computer activity if they had not finished in the specified time slot. The researcher noted this happening on at least three occasions during Week 3, as illustrated by the following extract from his Observation notes, in which some children finish off some work that they had started before lunch:

> 1.04 Children came in and started to settle down. 2 children went straight to the computer and started working on Graph Plot, which was already loaded. One of them didn't even stop to take her coat off first.
>
> Mrs Light stood in the shared area, supervising the children coming in from the playground. She asked the children to get on with silent reading. Most of the children were seated at tables. A third girl came over to the computer and sat down.
>
> 1.07 Mrs Light came into the classroom and prompted the girl at the computer who was still wearing her coat to remove it.
>
> Mrs Light then stood at the front of the class, by her desk, doing the register in a relaxed manner.
>
> (Observation notes 19th Jan)

This use of the computer within other subject slots on the timetable fitted in with the impression created by the Medium Term plans for ICT that the computer was being used as a tool to support children in carrying out other tasks. This was reflected in the researcher's observation of questionnaires that the children had produced using Pendown and some logos that they had created using a drawing/painting package (Photograph 6.4). They appeared to have chosen to use Pendown rather than Junior PinPoint to produce the questionnaires because they were familiar with how to operate Pendown and didn't want (or have time) to learn how to use Junior PinPoint. This provided further evidence that the reason for using the computer was to support learning in other areas rather than to learn about the technology.

Photograph 6.4 An example of a logo created on a computer

In contrast, their use of the Pocketbooks suggested that the main reason for using them was to develop the children's ICT skills. It was clear from the researcher's observations that the children were copy typing on the Pocketbooks, having written and then corrected previous drafts on paper. This was substantiated by the children in informal interviews:

Researcher	Right, so with your pocketbook stuff, do you write the stuff out in long-hand first and then type it up in the pocketbook or do you write it straight into the pocketbook?
Kye	No, we do it in draft first.
Researcher	On paper?
Kye	Yes. Yeah or in our draft books, and then when it comes to the day when we'd write them up we type it up on the pocketbook.

(Interview 19th Jan)

Indeed it seemed to be the case that some children wrote a first draft and a best copy on paper before typing out a copy on the PocketBooks:

Researcher	So you have to go back to your story and your drafting book and correct the drafting book
Robin	Yeah
Researcher	and then what will you do?
Robin	And then I'll copy it out in this …. My English book.
Researcher	Into your English book. And will you put it into the PocketBook as well?
Robin	Erm, yes I think so.

(Interview 21st Jan)

Further confirmation for the main focus for the use of the Pocketbooks being on developing the children's IT skills came from an interview with Mrs Light:

> Mrs Light — And that activity happens here [pointing at Tuesday am English slot on weekly timetable], starts here and they're written in draft and then the pocketbook activity [pointing at Wednesday am slot on weekly timetable] is transferring it so that the pupils are actually physically opening up a file, save it, writing, saving, all those things.
>
> (Mrs Light, 19th Jan)

It was clear that the use of the Pocketbooks did not impact on the curriculum, other than adding in some IT skills. The other computer use, which focused on the use of an adventure game (Crystal Rainforest) and generic software to support learning in other areas, had the potential to alter the curriculum. Indeed, it would have been difficult, if not impossible to replicate Crystal Rainforest without a computer. However, Mrs Light claimed that the computer use had not changed the curriculum in any way, other than by adding in IT skills (Questionnaire 6th Feb). She also said that computer use had not altered progression within the curriculum though it did alter the speed with which children worked. Using Graphplot to analyse the responses from the questionnaire the children produced using Pendown was a case in point, where using the computer had increased the speed with which work had been completed.

Computer use did not always speed up the children's work however. For example, it was clear to Mrs Light that using Magpie was going to take a long time. She therefore decided to delay it to later in the year. Whilst the time it would take the children to use Magpie was clearly an issue it was also possible that Mrs Light felt she needed more time to become familiar with it herself. She noted that there had been several workshops for teachers in the school on using Magpie, but that she was not sure how to use the scanner to create images or how to add sound (Mrs Light, 19th Jan).

The lack of apparent impact on the curriculum may have reflected Mrs Light educational stance prior to the arrival of computers. She clearly wanted the children to feel that their work was relevant and purposeful to the real world and this was reflected in the amount of time that the class spent working on their Rainforest Café project. This involved setting up a café in the school in order to raise money to buy a small section of Brazilian rainforest. In setting up the project Mrs Light had made links with an environmental group, a local bank and bakery, and at least one other school. The children in 5SL were in contact with people in all of these organisations both by letter and through visits. The children's work on the project involved communicating with a range of audiences, including other children in their own school, parents, and other members of the local community. For example, they created posters to advertise their Rainforest Café (Photograph 6.5), which were put up around school, with stickers being put up in local shops (Observation notes 19th Jan). This project culminated in representatives from the local community coming to the official opening of the Rainforest Café in the school.

Photograph 6.5 Examples of the posters the children had created to advertise their Rainforest Cafe

Mrs Light had made explicit links between the work on the Rainbow Café and the children's academic work. For example, her English planning specifically addressed issues of audience (Figure 6.3). None the less there appeared to be a tension between this work on the Rainforest Café and work on the core curriculum (English, Maths and Science).

Figure 6.3 Extracts form Mrs Light's English planning[3]

4. Choosing an Audience Write a whole story using a picture or object as a stimulus. A Year 7 child will draft it with the author. Share it with an audience or record it. 5. Throughout the half term weekly diaries would have been written then sent to Greenly School in Telford. In the last week all this work will be brought together and there will be a focus on the work the children have done on their Rainforest Project.

This tension was reflected in a split between more formal school work in the mornings and work on the Rainforest Café in the afternoons (as a general rule). It was also apparent in differences between the audiences the children wrote for and the ways in which the computers were used. Thus, whilst working on the Rainforest Café their target audiences always seemed to be important and clear, but this was not the case for their more formal English work:

Researcher	When you're doing the stories, who else is going to get to read them?
Nancy	Oh, I don't know.
Researcher	You don't know. Ok. Mrs Light will read them presumably? Do you usually read each other's stories?
Nancy	Sometimes.
Researcher	Sometimes. And usually, if you're gonna read them, do you get told before you write them that you're gonna read them, or do you just find out afterwards?
Nancy	We just find out after

(Interview 21st Jan)

Similarly, the computer use that was linked with their English work was very much focused on learning about ICT, whilst their computer use that was linked with the Rainforest Café involved the use of generic software and an adventure game.

[3] This is a transcripts as the originals are too feint to scan

Roles

Mrs Light estimated that she spent an average of 20 minutes per day supporting computer use, and that this was the only adult support the children had when using the computers (Questionnaire 6th Feb). The researcher's observations did not confirm this level of involvement, which he noted amounted to no more than 10 minutes per day on the days when the computers were in use. Where Mrs Light was observed supporting children who were using the computers her main roles seemed to be organisational, in the sense of saying who should be using which computer, or technical. For example, she set up the computer for two boys who were going to use Crystal Rainforest and said that Josh would show them how. She then left them to work on it until the end of the session, despite the fact that they were having some difficulties:

2.25 The boys on computer got stuck, they said to Josh, who was still working close by that they couldn't do this bit. Josh prompted them: "you have only had a little go" but did not come over to the computer or offer any further advice. The boys on the computer had another go at solving the problem.

2.28 One of the boys on the computer called over to Josh, "We can't do the lines." Josh came over and gave them some advice, he then took over the mouse and tried to solve the problem himself, but got it wrong. He stopped, apparently thinking, then took over the mouse again and has another go. Still without success. Josh then left and went back to his mask work. [The problem they are trying to solve involved controlling lights using Logo like commands]

The boys on the computer continued to struggle with the problem, trying different commands but not appearing to make much progress.

…

2.49 Mrs Light said that it was time to clear up. She came over to the computer and took over control of the mouse. She then talked the children through how to solve the problem, as she did it.

Children were returning to the class from the shared area. There was a good deal of milling around. Several children stood waiting for Mrs Light, who was explaining to the boys on the computer how to exit from the software. She saved their position in Crystal Rainforest for them.

2.51 Mrs Light waited for the computer to save the children's position. She told them that they were about half way through the adventure.

2.52 Mrs Light finished closing down the computer and focused on settling all the children down. The boys on the computer returned to their own class.

(Observation notes 19th Jan)

Much of Mrs Light's support for computer activities was provided 'at a distance'. For example:

> 10.31 Mrs Light - to whole class - instructions about how to close down PocketBooks.
>
> (Observation notes 21st Jan)

> 11.09 Peter to Acorn.
> Warren - 'What you doing?'
> Peter - 'Going to print with any luck'
> Warren - 'I know how to do it' and got up to show him. Some discussion. Peter thought he knew better. Bit of experimenting going on.
>
> 11.10 Warren - 'Need paper'
>
> 11.14 Warren and Peter still struggling with printer - asked Mrs Light how to do it - she told them (switch on side) and it worked. {Mrs Light did not come over to the computer but told them from where she was working}
>
> (Observation notes 21st Jan)

This last extract showed Warren trying to help Peter when he got stuck. Despite claiming that she was usually the source of expertise within the class, with the children and other adults only occasionally taking on this role (Questionnaire 6th Feb), Mrs Light appeared to be happy with the children helping each other out in this way. She explicitly used children to support others, particularly when they were new to a piece of software. This was apparent in the way that Crystal Rainforest was used as evidenced by Mrs Light's response in the Interview on Jan 19th and the observations on the same day.

> Researcher And for these other activities, like the Crystal Rainforest and Magpie, do they do that in pairs or in ?
>
> Mrs Light Crystal rainforest certainly in pairs, and <indecipherable> would be prompted by the last group to do it would be helping the next group.
>
> (Interview 19th Jan)

1.17 Mrs Light then started setting up Crystal Rainforest on the computer. She asked a child (Josh) to introduce the program to some other children, and then explained the main steps in using the software to him. [Josh appeared to have used the software before]. Mrs Light then left the computer and went into the shared area. Josh waited by the computer.

1.18 3 or 4 children were milling about, unsure what to do. They asked the teacher who directed them. Two boys came over to the computer and sat down. [Both these boys were from the parallel Yr5 class. The two classes were working together on their Rainforest topic, and the two classes appeared to work as one 'team teaching' unit during these sessions]

Mrs Light came over to computer. She said that Josh would show the boys what to do. She then started to tell them herself, but stopped herself and said, "Sorry Josh - you do it."

Josh started to tell the other two boys what they had to do. The teacher went to see another group of children.

(Observation notes 19th Jan)

As had been the case with Peter and Warren, the peer tutoring often appeared to be initiated by the children rather than Mrs Light. Indeed, on the basis of the researcher's observations, this seemed to be the main source of support for computer use within the classroom, as illustrated by the following examples which were all noted during a two hour period:

9.45 Suddenly Damian said, "I can show you something" to Peter and took over control of the computer's keyboard. They then took turns showing each other features of Pendown. For example, Peter demonstrated the spell check to Damian.

(Observation notes 21st Jan)

10.30 SL showing a boy how to save his work {on a PocketBook}.
Hannah called out "How do you save?"
SL explaining - starts to do it out loud.
Peter told Hannah how to save. {Hannah did not follow SL's explanation cos it was too fast and then Peter stepped in to help}

(Observation notes 21st Jan)

11.31 Nancy on computer - doing file transfer (Peter showed her how to do it she said).
Peter not at computer.

11.34 Nancy fetched Peter cos she got stuck on file transfer. He took over mouse.

11.35 Peter and Nancy continued with the file transfer. Once the file is copied across they started to edit it in Pendown.

11.40 Nancy and Peter continue to edit Nancy's story, and use the spellchecker (Photograph 6.6).

(Observation notes 21st Jan)

Photograph 6.6 Nancy and Peter editing Nancy's story on the Acorn

This apparent freedom for the children to support each other, even when, as in the last example with Peter and Nancy, it meant one child coming off the task that he was meant to be doing, seemed to fit with Mrs Light's view of her classroom. She noted that the locus of control varied within her class, ranging from her having total control at some times to the children having control at others (Questionnaire 6th Feb). This perception of the children having control at times seemed a little misleading however. It was clear that Mrs Light retained all the power in the relationship, in the form of being able to grant or withhold permission for the children to 'be in control'. This was most evident in relation to the use of the Pocketbooks, as illustrated by these related extracts:

10.01	Mrs Light - 'start in draft book. ... Sit in your places' Peter (to me) "I'm allowed to do it straight into a Pocketbook" and goes out of class to get a chair.
10.02	Peter sits in his usual place {Table C on plan} - kids by him ask if he is allowed to do it straight into a Pocketbook - they seem surprised.

(Observation notes 21st Jan)

Researcher	But why don't you do the whole thing in the PocketBook?
Peter	Well, I don't know, Mrs Right just does it, that's why.
Nancy	We have to do it first in our draft book, so she can check it.
Researcher	So perhaps if she let you do yours in the PocketBook …
Peter	Yeah, I don't know why …
Researcher	Did you ask her?
Peter	Yeah, I asked if I could do it straight up in the PocketBook, and she said 'yes', but…
Researcher	Have you ever done that before?
Peter	No.
Nancy	No. I haven't.
Researcher	Have you ever asked to do it before?
Nancy	No.
Researcher	No. So do you think if you ask her again, she'll let you do it again?
Peter	Maybe.
Nancy	Maybe.
Researcher	Maybe.
Nancy	Probably not….

(Interview 21st Jan)

It may well have been that Mrs Light was happy to let the children help each other on the computers, even where this meant a child coming off-task because this relieved the pressure on her. Had she not allowed this to happen she would have to have spent considerably more time herself working with the children who were using the computers.

Organisation of computer use

The main form of organisation of computer use within the class was for children to work in pairs (Questionnaire 6th Feb, Manual Logs, Observations). This applied whether the children were using the single Acorn machine, or using the school set of PocketBooks. On rare occasions small groups used the Acorn machine (once according to the Manual Logs). However, it was clear that much of the work on the PocketBooks was completed individually:

Researcher	Did you write that together, or is that something Robert did?
Stuart	Robert did.
Researcher	Robert did. So what are you doing with Robert?
Stuart	We're sharing pocketbooks.
Researcher	You're sharing PocketBooks. So what does that mean, I mean Robert's going to type the whole story, and you help him when he gets stuck, how's it going to work?
Stuart:	Robert's typing his story, and when I finish my ending and I'll write my ending there.
Researcher	And when you're writing yours up on there, what will Robert be doing?
Stuart:	I I'm not sure …. (inaudible, background noise).

(Interview 21st Jan)

The rationale for the size of groups often appeared to be pragmatic, related to the availability of resources:

Researcher	OK. Is it usual when you do your writing that you'll work with a partner who'll correct your draft?
Louise	Erm, only … beginning to the end.
Researcher	So only in that bit of English, OK. And when you're doing your other English, do you normally work alone?
Louise	Yes.
Researcher	Yeah. OK.
Louise	Sometimes if you you'll have to do, looking at dictionaries, looking for words, and then we do it with a partner, 'cos we can't have enough dictionaries…
Researcher	Right. But usually you only do it when you've got something where there is not enough things to go round.
Louise	Yeah.
Researcher	Is that what you do with the PocketBooks as well?
Louise	Yeah.

(Interview 21st Jan)

This grouping in order to overcome shortages of resources was reflected in the way in which the children appeared to work together on the PocketBooks. They corrected each other's rough drafts (on paper) before taking turns to use the PocketBook to enter their own story:

Amitar: W	and Mrs Light said we give it to the next person beside us, so they go through with us.
Researcher	So they go through and correct your corrections?
Amitar	Yeah.
Researcher	OK. And so you two work as a pair, Amitar you will correct Nancy's and Nancy will correct yours.
Amitar	She'll write on mine and I'll write on hers.
Researcher	OK. And then you take it into the PocketBook.
Amitar	Yeah. We both have different files.
Researcher	You both have different files.
Amitar	Yeah.
Researcher	Do you then read what she's put in the PocketBook, and correct what she's put in the PocketBook, or you only do it on paper?
Amitar	Only do it on paper. We mark on paper and not on the PocketBook so ..
Researcher	OK, so that when you put it into the PocketBook, it's already been completely corrected and you just have to type it.
Nancy	Yes.

(Interview 21st Jan)

There was evidence in some cases that when they were drafting the children worked collaboratively to improve the piece of writing in question, although on the basis of the researcher's observations, this seemed to be the exception rather than the rule:

> 11.50 Rachael drafting Warren's story - in his drafting book - Correcting spelling and grammar (see Photograph 6.7). If she wants to add/change words she talks to Warren about it first. Rachael writing corrections in blue ink. {When she's finished correcting Warren's story} then Rachael will type her own story into the PocketBook. {I went over and asked them what they were doing and how it was organised - then wrote the notes above}

(Observation notes 21st Jan)

Photograph 6.7 Rachael 'drafting' Warren's story

When using Crystal Rainforest the pairs of children had one shared outcome: to find Gomez. Perhaps not surprisingly, there was more evidence of collaboration in this context, as illustrated by this extract from the Observation notes:

1.23 …

One of the boys at the computer was controlling the mouse. The other one was telling him what to do, but he did not always do as he was instructed.

1.30 The boys swapped over, so that the second one was now controlling mouse. [He then retained control of the mouse for most of rest of the session]

…

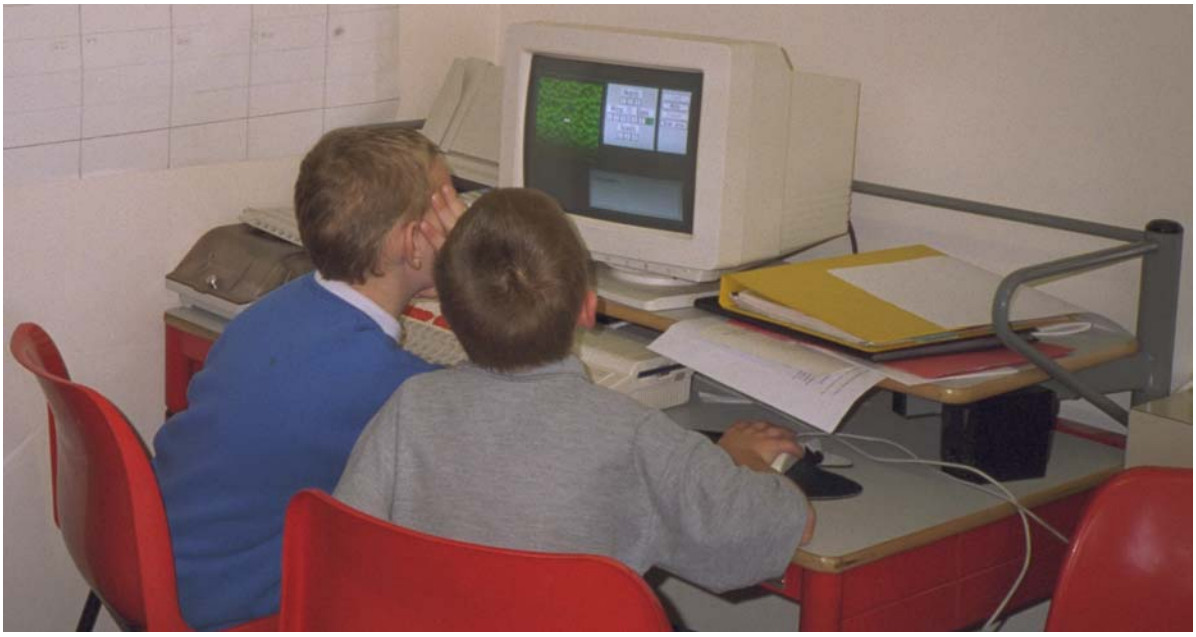
1.32 …

The two boys continued to use the computer, discussing what to do as they went. [At this point the researcher moved out into the shared area to conduct informal interviews with other children from the class]

(Observation notes 19^{th} Jan)

As Photograph 6.8 illustrates, both the boys remained focussed on their joint task irrespective of which one of them was controlling the mouse.

Photograph 6.8 Two boys focused on Crystal Rainforest



There was also evidence of the children working collaboratively when using generic software to support their Rainforest Café project. For example, when developing the questionnaire in Pendown and analysing the data using Graphplot.

In order to facilitate children working collaboratively or co-operatively in groups Mrs Light said she usually based them on competence. She said that she also sometimes used friendship, interest or gender as the basis for selecting members of a group (Questionnaire 6th Feb). Her emphasis on ability reflected her comment that when using Magpie in the second half of the term she:

> may pair maybe pair out a more able with a less able, to cover the fact that they need that little bit more help
>
> (Mrs Light, 19th Jan)

In the wider context of the class the children recognised this form of grouping, but also seemed to think that gender was an important factor:

Laura	She mixes us with people who are better than us, and ..
Researcher	Right, OK. And she mixes boys and girls together, or what?
Laura	Yeah, it's usually girl-boy, girl-boy.

(Interview 21st Jan)

Some of the children also perceived there being a more basic managerial element to the way in which groups were composed:

Jane	Some children get along with each other and some of them don't.
Researcher	OK, so it's to do with who you argue with and who you don't argue with, and that sort of stuff is it?
Jane	Yeah. And the people that slow you down at working.

(Interview 19th Jan)

Recording of computer use

Mrs Light reported that she spent 5 minutes per day recording the children's progress on computer related activities, though this was sporadic rather than on a daily basis. There were two forms of recording in evidence within the classroom: a mark book in which Mrs Light indicated when a child had undertaken/completed an activity and folders containing annotated samples of children's work. However, there was no evidence of any recording of the children's computer related work. Thus, Mrs Light was not observed recording the children's progress on computer related activities, her record book made no reference to any IT activities and there were no relevant samples in the sample folders. The lack of samples may not have been a good indicator, as it seemed from the contents of the folders that work was added at the end of each term rather than on an ongoing or daily basis.

Description of the practice surrounding computer use based on the Computer Practice Framework

The researcher made a holistic judgement about the computer use in 5SL on the basis of his observations in the class and other data collected (Table 6.5).

Table 6.5 Researcher's holistic judgement of the computer use in 5SL based on the CPF

Quantity		Focus			Mode		
Rating	%	Category	Rating	%	Category	Rating	%
Some	15	Pragmatic	Some	30	Repetition	QaL	60
		Computing	QaL	50	Replacement	Some	20
		Learning	Some	20	Extension	Some	20

The teacher was asked to rate her classes' computer use against the CPF in the Teacher

Questionnaire (Appendix D). Her responses are summarised in Table 6.6.

Table 6.6 Mrs Light's holistic judgement of the computer use in 5SL based on the CPF

Quantity		Focus			Mode		
Rating	**%**	**Category**	**Rating**	**%**	**Category**	**Rating**	**%**
Some	<1 - 10	Pragmatic	Some	26 - 50	Repetition	Some	26 - 50
		Computing	Some	26 - 50	Replacement	None	0 - 25
		Learning	Some	26 - 50	Extension	Some	26 - 50

Each of the activities in the first half of the spring term was also rated against the CPF, on the basis of all the available evidence. Table 6.7 shows an example of the analysis of one activity. Full details of this analysis are included in Appendix F.

Table 6.7 An example of the analysis of one activity using the CPF

7th Jan	**Using Pocketbooks to write up best copy of part of a story**			
Quantity	105 minutes (105/300)			
	%	35%		
Focus	Manual Log **-** The majority of the class used the PocketBooks "To write part of a story in best". Observation of other sessions in which the children used the PocketBooks (as described previously) suggested that they were simply copy typing. The focus on producing a best copy might have suggested that one of the reasons for using the computer might have been presentational. Plans - The medium plans for the previous term contained very few references to IT (two mentions under geography) and no mention of the PocketBooks. This might have suggested that the class teacher had increased her level of IT use in response to the knowledge that a researcher who had an interest in computer use was coming in. Informal interview (30.1.98) – Mrs Light said that she had agreed to take part in the research because the IT was not built into her planning, it was added on/separate.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%	30	70	0
Mode	Manual Log and non-participant observation of other sessions in which the children used the PocketBooks both suggested that the activity here was copy typing. Observation of the children on subsequent occasions using the PocketBooks and discussion with them indicated that they had used them before in much the same way. This activity thus constituted Repetition. There was no evidence of the children drafting on the PocketBooks, which might have moved it from Repetition to Extension.			
	Category	**Repetition**	**Replacement**	**Extension**
	%	100%		

These individual descriptions for each activity were then weighted on the basis of the number of children who had been involved in the activity and the length of time it had lasted (see Appendix F). These weighted ratings were then combined to establish the weighted rating each day for the computer use in 5SL against each of the dimensions of the CPF (see Appendix F). These daily rating were then averaged to give an overall rating of the computer use in 5SL against each of the dimensions of the CPF (Table 6.8).

Table 6.8 Holistic rating for the computer use in 5SL based on an analysis of the individual activities

Quantity		Focus			Mode		
Rating	%	Category	Rating	%	Category	Rating	%
Some	17	Pragmatic	Some	28	Repetition	Lots	94
		Computing	QaL	51	Replacement	None	0
		Learning	Some	21	Extension	Some	6

Examination of the data from Case Study 4 in relation to the criteria for evaluating frameworks for describing and thinking about computer use in education is reported after the section on Case Study 5.

Case Study 5

The Case Study 5 class (6TH) was a Year 6 class (10 - 11 year olds) of 30 (14 girls and 16 boys). One of the children (Adam) had severe learning difficulties. The class teacher (Mrs Henry) had been teaching for approximately 8 years. She held the post of responsibility for IT and the behaviour policy within the school.

During the Spring Term, when Case Study 5 took place, 6HT had access to: one Acorn computer in the classroom; one Acorn PocketBook for Adam's individual use as part of his SEN provision; and approximately 20 Psion PocketBooks, shared across the whole school and stored in the secure central stock cupboard. They also had occasional access to two computers outside the Y7 class.

Rich description of the practice surrounding computer use

The space allocated for computer use

Photographs 6.9 and 6.10 show that 6TH was an airy room that opened out onto an area that was shared with a number of other later years classes. The opening between the shared area and the classroom could be shut off with a curtain (Photograph 6.10). Each child had an allocated place on one of the tables, which they used most of the time. The exceptions being when they were in ability groups (e.g. for Maths) or having whole class discussions.

Photograph 6.9 6TH, looking in from the shared area

Photograph 6.10 Looking out from 6TH into the shared area

The class' desktop computer was located on a built in shelf that ran along the back of the classroom (Photograph 6.11 – rear left). This shelf was slightly wider than the computer and the keyboard had to be used to the left hand side of the computer. Mrs Henry recognised that this was a low quality environment for using the computer (Questionnaire 6th Feb – see Appendix D).

Photograph 6.11   The computers inside 6TH

Adam's PocketBook, being small and portable, was used in a range of locations around the classroom, although the most common of these was on Adam's table (Photograph 6.11 – bottom right). This Pocketbook was stored on the shelf at the back of the classroom, next to the desktop computer. On the rare occasions when the class used the school's set of PocketBooks the children used them on their normal tables.

Overview of computer use

During the first half of the Spring term 6TH used the computer and PocketBooks for: data logging in Science; finishing off posters on World War II started in the previous term (Kidpix); mathematical investigations (Monty) and data handling (Graphplot) during maths sessions; and looking at time zones during Geography (PocketBooks). In addition, two children with Statements of Special Educational Needs, Adam and his twin brother who was in class 6GG, used the computer to learn to touch type during assemblies. During lessons Adam used his PocketBook for word processing rather than writing by hand, often with Mrs Henry acting as a scribe (Photograph 6.12). Mrs Henry also used the classroom computer for administrative purposes (e.g. producing certificates).

Photograph 6.12 Mrs Henry scribing for Adam on his PocketBook

During the first half of the Spring term the computer use with children in 6TH was of three main types. Firstly, they used 'generic tools' to support work in other curriculum areas, including: data logging in Science; finishing off posters on World War II started in the previous term (Kidpix); and data handling (Graphplot) during maths sessions. Secondly, they used 'useful little program' to support work in other curriculum areas, including mathematical investigations (Monty) and looking at time zones during Geography (PocketBooks). Thirdly computers were used to support children with special educational needs (focussing on communicating through text).

The quantity of computer use

Mrs Henry estimated that on average one or more computers were in use in her class for 60 minutes per day. Taking into account the number of computers being used, she estimated that the average amount of time children in her class spent using computers was around 90 minutes per day.

Mrs Henry co-planned with the other Year 6 teacher. It was noticeable that Mrs Henry's plans were word processed and made reference to ICT across the curriculum, whilst the other teacher's plans were hand written and made many fewer references to ICT. Mention of the statemented twins using their pocketbooks was a frequent feature of the Mrs Henry's planning, particularly in relation to science (see Figure 6.4 for an example). Mrs Henry's Medium Term Overview made extensive reference to ICT during the first half of the Spring Term (see Table 6.9) both under the heading ICT and under History. However, Mrs Henry commented in interview that

> We're not actually doing history this term, we did history last term. We're doing Geography this term. But in the ICT once we get us organised, I want to start them on the multimedia,
>
> (Mrs Henry, 21st Jan)

The only evidence of any of the History related ICT having taken place was one entry in the Manual Logs for Week 3, which mentioned that two boys had worked on their World War II posters using Kidpix. This took place on a Monday afternoon whilst the rest of the class were doing Games, which might suggest that it was a 'filler activity' designed to occupy a couple of children who were not able to do PE.

Table 6.9 Excerpts from Mrs Henry's Medium Term Overview Plans, which mention ICT

Date	Week	ICT	History
6th Jan	1	Continue Kidpix – posters, Textease – news papers, Mapie – WW2, Monty	As ICT
12th Jan	2	Data logging	As ICT
19th Jan	3	Pocketbook spreadsheet Graphplot	As ICT
26th Jan	4	Pocketbook spreadsheet Graphplot	As ICT
2nd Feb	5	Pocketbooks Timezones	As ICT
9th Feb	6		As ICT
16th Feb	Half term		

Mrs Henry's medium term plans for each subject made extensive mention of ICT (see Figure 6.4 for an example) and these were cross referenced with the medium term ICT plans, which covered the term as a whole (Figure 6.5).

Figure 6.4 Medium Term Science Plan for 6TH during the first half of the spring term

Medium Term Planning — Curriculum Area: Science — Spring Term 1998

Year Group: 6 — Theme: Materials / Sound — Teachers: Mrs.Henry, Mrs Fredrickson

WEEK/ A.T.	LEARNING OBJECTIVES	TASKS / ACTIVITIES	ASSESSMENT / DIFFERENTIATION
Focus 2 1b	Heat travels from a warmer to a colder material. Some materials conduct heat more effectively than others. Materials which are bad conductors are good insulators and can be used to keep things warm.	Carry out a test to find which materials will keep a container of hot water warmest. Monitoring and recording of results will be done by using a datalogging programme with temperature sensor (See ICT programme.)	Mixed ability whole class lessons, followed by co-operative work in mixed ability groups. Adam - C.A. OR C.T. will scribe work on Pocket book. Assessment by outcome - teacher assessed. Formal assessment 'test' at the end of unit.

Figure 6.5 Mrs Henry's Medium Term Plans for ICT in 6TH during the Spring Term

Medium Term Planning — Curriculum Area: I. C. T. — Spring Term 1998

Year Group: 6 — Theme: Developing Skills — Teachers: Mrs Henry, Mrs Fredrickson

WEEK/ A.T.	LEARNING OBJECTIVES	TASKS / ACTIVITIES	ASSESSMENT / DIFFERENTIATION
Maths focus 3d	Continue developing use of Monty to support number work and understanding of pattern.	Children will work in pairs to experiment and investigate number and multiplication patterns of increasing difficulty.	Within Maths groups. By outcome. Children will advance levels as they individually master them.
2a,d	Support study of Data handling. Develop understanding of graphing data and use of a spreadsheet to manipulate and interpret data.	Children will use Graphplot to enter data and develop an appropriate graph to interpret the data. Children will be introduced to a spreadsheet relating to planning a party. They will experiment and investigate the results of altering the data to develop an understanding of how the spreadsheet works. They will learn to enter formulas and data into a spreadsheet.	Within Maths groups. Levels based on abilities. By outcome.
	Develop use of Logo to develop understanding of shape and the relationship of angle to shape.	Children will use Logo to explore and develop understanding of shape and angle. They will be given tasks to complete, to draw given shapes using Logo, to develop a sequence of commands, to develop a repeat loop of command.	Within Maths groups. Levels based on abilities. By outcome.
and Geography 1b	Develop an understanding of time zones.	Children will use the time facility of the Pocket books to investigate time zones. The work will relate to mathematical work on time and geographical work on latitude, longitude and time zones.	Within Maths groups. By outcome.
Geography 1b	Mapping skills.	Children to work on different mapping skills - scale, co-ordinates, direction, grid references - to enhance their understanding.	Mixed ability groups. Children will work co-operatively in pairs.
Science 3b	Develop knowledge and understanding of the use of sensors to detect change.	Through their Science studies, the children will learn to make use of datalogging to sense change. In an investigation of insulating properties of materials they will use temperature sensors to discover the best insulator. In an investigation of noise pollution they will use sound sensors to discover which material has the most efficient sound proofing qualities.	Mixed ability groups. Children will work co-operatively to investigate and evaluate. Adam will use Pocketbooks to write up results. By outcome.
History 2a,b,c	Continue developing knowledge and understanding of software to support History work.	The children will continue working with Kidpix to create a war time poster using the range of facilities of the programme. The children will continue to use Textease to create a newspaper front page about the outbreak of war and the key events leading up to it.	Mixed ability groups. Children will work co-operatively in pairs.
	Using Britain since 1930s data file to search for and retrieve information. Using CD-ROM to search for and extract information through notepad facility. Investigating a period of history and presenting it in an interesting format for an audience, using Magpie multimedia.	The children will review what they have learned about Britain since the 1930s and further investigate the main events up until the end of the war using a variety of reference materials, including a datafile and CD-ROM. They will work on individual areas to write a multimedia presentation using Magpie. Later in the year they will be able to add to their presentation as they study the period after the war.	Mixed ability groups. Children will work co-operatively in pairs.

Comparing the Manual Logs for Week 3 (19th to 23rd January) with the medium term planning for 6TH suggested that the medium term plans were not a totally accurate indicator of what took place. Thus, whilst these plans did mention all of the computer use that occurred in this week, they often indicated that this use would occur at some other time. In addition, some of the computer use that was specified in the medium term plans as taking place during Week 3 did not occur (i.e. use of the PocketBook spreadsheets). Mrs Henry was aware of this, and in relation to the medium term plans commented that:

Mrs Henry	That's what we started out with, and as you can see my group, it's taking them much longer to get through the data handling. We originally thought two weeks, which is eight lessons, but this is the lowest group, and I've got two groups within it, as you can gather, one very poor, and one fairly poor, where we're having to do a lot of practical things, a lot of ?, explaining it, a lot of working on the board together, before they can actually understand it, so it's taking me longer than I had planned. But I'm not worried about it, I'm just gonna go over it until they've understood. Now we introduced ? graph today, so tomorrow they are going to go and do their own survey, collect some data, and then they will build their own graph ….
Researcher	Right. But basically your medium term plans will be modified and fit in with whatever.
Mrs Henry	Absolutely, yeah, and if necessary I'll leave probability out this half term and do it…

(Interview 21st Jan)

Mrs Henry's weekly plans did not appear to be any more accurate than her medium term plans. Thus, comparison between the Manual Logs and observation data and the weekly plan for Week 3 showed similar discrepancies (see Table 6.10). The weekly plan for Week 3 identified Graphplot being used for data handling on Tuesday and indicated that data handling would continue for the rest of that week, although no further reference was made to Graphplot. This was the only mention of the use of ICT by 6TH during Week 3. The Manual Logs and observations showed that some computer use took place that was not identified in the weekly plans (indicated in italics in Table 6.10) and computer use that was planned did not take place (i.e. Graphplot on Tuesday, see Table 6.10). However, Graphplot was used during the maths slots on Wednesday, Thursday and Friday.

Table 6.10 Timetable for 6TH in Week 3
(plain=planned; italics=unplanned ICT; bold=planned and implemented ICT)

<table>
<tr><td>Monday</td><td>Humanities</td><td>English</td><td rowspan="5">B
R
E
A
K</td><td>Science</td><td rowspan="5">L
U
N
C
H</td><td colspan="2">Games
Kidpix</td></tr>
<tr><td>Tuesday</td><td>Assembly
SEN typing</td><td>Maths
<s>Graphplot</s>
Monty</td><td>PE</td><td>Art/DT</td><td>Science</td></tr>
<tr><td>Wednesday</td><td>Forum</td><td>RE
SEN PB</td><td>Maths
Graphplot</td><td colspan="2">Humanities</td></tr>
<tr><td>Thursday</td><td>Assembly
SEN typing
Admin</td><td>Maths
Graphplot</td><td>Music</td><td>PSHE</td><td>French</td></tr>
<tr><td>Friday</td><td>Assembly
SEN typing</td><td>English
SEN Write</td><td>Maths
Graphplot</td><td colspan="2"><s>Art/DT</s> Finish Science
SEN –Write</td></tr>
</table>

The Manual Logs indicated that the total amount of computer use during Week 3 was 6 hours and 30 minutes. This included 33 minutes by Mrs Henry outside class time, and 2 hours 22 minutes by one or both of the statemented twins (see Table 6.11).

Table 6.11 Summary of the amount of computer use in 6TH during week 3 according to the Manual Logs

Description of use	Amount	Mean (minutes per day)
Mrs Henry (Admin)	33 mins	7
SEN children	2 hrs 22 mins	40
Other children	3 hrs 35 mins	43
Total use with/by children	5 hrs 57 mins	71
Total use	6 hrs 30 mins	78

Week 3 appeared to be fairly typical in terms of its computer use in the first half of the Spring Term. Overall, despite the discrepancies between the plans and what was actually implemented, the evidence suggested that Mrs Henry's estimate of around 60 minutes per day was reasonably accurate in relation to the first half of the Spring Term. Total computer use with children averaged 71 minutes per day in Week 3, or 43 minutes per day if the SEN children's computer use was excluded.

Planning and the curriculum

Mrs Henry reported spending an average of 30 minutes per week on planning linked with computer related activities, although she indicated that this tended to be concentrated in intensive blocks rather than being spread throughout the term (Questionnaire 6th Feb). The thoroughness of her medium term planning seemed to confirm this. For example, all her plans were integrated in the sense that her ICT plans (Figure 6.5) mapped onto her plans in other subject areas (e.g. Maths plans in Figure 6.6) and visa versa.

Figure 6.6 Maths planning for the first half of the Spring Term in 6TH

Medium Term Planning | Curriculum Area: Mathematics | Spring Term 1998

Year Group: 6 | Theme: | Teachers: Mrs Henry

WEEK/ A.T.	LEARNING OBJECTIVES	TASKS / ACTIVITIES	ASSESSMENT / DIFFERENTIATION
Week 1 - 2 U+A3b.c HD 1b.c. 2a. b.c.	**Data Handling** ■ **bar graphs, pictograms, tallies, surveys, averages** ■ **bar graphs, pictograms, barline + trend graphs, tallies, mode, median, mean, class intervals, interpretation , surveys**	**Heineman 5 - work from text and workbook supported by introductory / practical activities. Follow up through homework to consolidate skills and understanding..** **Heineman 6 - work from text and workbook supported by introductory / practical activities. Follow up through homework to consolidate skills and understanding..** **See also I. C. T. programme - work in using Graphplot and a spreadsheet will support this focus of study.**	**Ability grouped lessons, further differentiated into 2 levels of ability. By Outcome. Support by teacher and classroom assistant.**
Week 5 S.S.+M 4a	**Time** ■ **clocks: nearest minute, a.m. / p.m., durations, calendars and dates** ■ **12 and 24 hour clock, a.m./ p. m. , durations and notations, the second**	**Heineman 5 - work from text and workbook supported by introductory / practical activities.** **Heineman 6 - work from text and workbook supported by introductory / practical activities.** **See also I. C. T. and Geography programmes - work in using Pocketbooks time zone facility will support this focus of study.**	**As above**

All of the computer use identified in the plans was linked in with learning in another curriculum area. Within the weekly timetable computer use was subsumed within other activities in the classroom and did not have separately identified time slots. Observation within the classroom and Mrs Henry's comments confirmed that this generally was the case. The only exception to this related to Adam, who was scheduled to do explicit IT activities, such as learning to touch type during the times when the other children were in assembly. This integration with other subjects was reflected in the fluidity of the computer use. Whilst the main activities within which the computer use was subsumed did have specific start and end times (Weekly timetables, Observations). This was not the case for the computer use itself, although it was often the case that the children would be given a target for how long they should take to complete an activity on the computer (Questionnaire 6th Feb):

> Rich Usually we're timed
>
> (Rich, a child in 6TH, 20th Jan)
>
> Mrs Henry You know, we can put them on at two at a time, and in the hour you can probably get three pairs on.
>
> (Mrs Henry, 21st Jan)

The close integration of computer use with other curriculum tasks suggested that the main reason for using computers was as a tool to support learning in other areas. For example, they used data logging equipment in week 2 of the Spring Term during a science session in which they were testing the best heat insulators. This had the potential to alter the focus of that activity, so that the children spent less time recording temperature as they tested various materials and more time on interpretation and scientific discussion. However, it was clear from Mrs Henry's description of the activity that using the data logging equipment did not change the nature of the task:

> What we did, they set up the experiment, with thermometers and then each group, I had them bring their, 'cos what they were doing was testing insulation, so they had a baby food tin, milk pan, with a jar inside it with some sort of insulation between the two and the water just up to the lid, and what they did was they brought that over, two groups at at a time, so there were two cans to compare, we put the tester in each one, and they watched it for 5 minutes. They didn't actually do it themselves,
>
> (Mrs Henry, 21st Jan)

This seemed to confirm Mrs Henry's claim that using computers had not changed any aspect of the curriculum, other than by adding new content in the form of IT skills, knowledge and/or understanding. Furthermore she said that using computers had had no impact on the speed with which the children in 6TH had progressed through the curriculum or on the order in which they tackled different aspects of it. Additional evidence that using computers had not impacted significantly on the curriculum or its transaction came from

Mrs Henry's comments about the audiences that the children's computer work was targeted at (Questionnaire 6th Feb), which were very traditional. She noted that 'the teacher' represented the main audience for the children's work and they would never produce work that 'the teacher' would not be expected to see. The children only occasionally did work that was intended for sharing with the whole class, the school or the wider community.

Whilst all the observations and most of the other data confirmed this view that using the computers did not change the curriculum Mrs Henry did talk about doing some multimedia work in the future. This would have introduced new forms of representation to the children (e.g. hyperlinks, sound, text, images, animation) and the intended audience for the finished work was the children's parents:

> Mrs Henry Really, it's a sort of, you know, maybe for parents so they can be out, where they can see what their kids have been doing, and you know, that's what I'm aiming for, and it's more than anything I just want to experience actually building a multimedia project, 'cos they've never done it. … I bought the software Resound, so they can put sound on,
>
> (Mrs Henry, 21st Jan)

Whilst hinting at the possibility that the children's future computer use might start to impact on the curriculum and intended audiences, this also countered the view that the main reason for using the computers was to support learning in other areas. Despite the fact that this activity was identified as being part of their History work it was clear that the main reason for using it was to give the children experience of multimedia authoring. This emphasis on 'wanting the children to have a go with IT' was also apparent to some degree in the use of the time zone software on the PocketBooks:

> we are sort of tying into the geography because they have to do longitudinal time zones there, so what we're going to do there is when we are doing time, it's just let them see that facility [i.e. the time zone facility on the PocketBooks] and experiment with it.
>
> (Mrs Henry, 21st Jan)

In addition, it seemed that Mrs Henry occasionally used the computer as a means of occupying children or as a reward. For example, two boys who were unable to do games on one occasion were allowed to use the computer to do more work on their World War II poster from the previous term. On another occasion, a child who was using Monty, when asked why he was using it said that "Mrs Henry selects people out if they've been working hard enough" (Richard, 20th Jan).

Overall, whilst the planning suggested that the main reason for using computers was to support learning in other areas there was evidence that computers were actually being used as an end in themselves and as a reward. In addition, the computer use was not having a significant impact on the curriculum or how it was transacted.

Roles

Mrs Henry reported spending an average of 15 minutes a day preparing for computer related activities. This was reflected in the researcher's observations. For example, Mrs Henry always made sure the class computer was turned on at the beginning of each day, and usually loaded the software that she wanted the children to use before they arrived. Similarly, she turned the computer off at the end of the day. In addition, Mrs Henry spent time installing software (such as Resound which she had bought for the children to use when making multimedia presentations) and familiarising herself with it.

When the children were using computers Mrs Henry estimated she spent approximately 20 minutes per day on average supporting computer related activities. She estimated that other adults also spent an average of 20 minutes per day supporting computer use with her children, although this was more sporadic (Questionnaire 6th Feb). The researcher's observations and the Manual Logs for Week 3 tended to support these estimates (see Table 6.12). Mrs Henry spent just over 20 minutes per day supporting computer use on average during Week 3. Mrs Green, the support assistant who worked alongside Mrs Henry during maths sessions, spent somewhat less than 20 minutes per day on average, but this may be due to the sporadic nature of her involvement.

Table 6.12 Summary of the amount of time Mrs Henry and Mrs Green spent supporting computer use during Week 3

Day	**Time spent (minutes)**			**Activity**
	Total support	Mrs Henry	Mrs Green	
Mon	0	0	0	
Tue	30	20	0	Touch typing with SEN twins during assembly
		7	3	Monty during maths session
Wed	45	15	0	Scribing for Adam during RE
		0	30	Demonstrating GraphPlot during maths
Thur	17	17	0	Touch typing with SEN twins during assembly
Fri	64	15	0	Touch typing with SEN twins during assembly
		15	0	Supporting Adam during English
		0	9	Working with a boy on GraphPlot during maths
		25	0	Scribing for Adam – best copy of science
Average per day	31	23	8	

The role of the adults was very much that of instructing the children. Mrs Henry stated that she usually maintained total control over when, what, where and how the children used the computers. She said that she did occasionally allow them to have slightly more control over some activities (Questionnaire 6th Feb). This view of generally tight teacher control over computer use was supported by: the match between the plans and actual implementation of computer activities; the researcher's observations; and comments made by the children during informal interviews. For example,

Researcher	OK, and who decides which it's going to be?
Rich	Mrs Henry.
Researcher	And does she tell you which bit of Monty to do?
Rich	She says, there's a grid that comes up and she says look at that first then you're going to get the hang of that and then she says, then all you have to do is press Enter and then it will come on. There's then this snake you move around and when you press Enter again it will stop and you have to find numbers on it.

(Interview 20th Jan)

However, there was also evidence of the children potentially being able to influence Mrs Henry's decisions. For example, on several occasions children asked Mrs Henry's permission to use the computer or alter what they were doing:

1.55 The computer was turned off. A child asked Mrs Henry if he could go on it. She said, "Not now."

(Observation notes 20th Jan)

2.23 Mrs Henry tells Adam she will scribe for him on his PocketBook as he dictates from his draft book (writing up his Science experiment).

2.25 Craig says to Mrs Henry that he wants to sit by Adam.

Mrs Henry: "We will have to talk about that."

Graham: "It's only cos he wants to play with the PocketBook."

Mrs Henry: "Exactly."

Craig: "But I would do my work."

Mrs Henry: "But would Adam?"

(Observation notes 23rd Jan)

In addition to Mrs Henry maintaining fairly tight control of the activities in the classroom, she thought that she was the main source of expertise within the class. She reported that the children only occasionally used other adults or children as sources of expertise (Questionnaire 6th Feb). This was reflected in the fact that there was no evidence of children in 6TH being used as peer tutors. However, Mrs Henry did make use of the oldest children in the school (Year 7) to help her maintain the computer equipment around the school, as illustrated by this extract from the Observation notes:

2.29 2 boys (from another class) come in and get box from cupboard. Mrs Henry asks them to clean the mice today. Checks they know how to take a mouse apart and clean it. [After the session Mrs Henry explained that these were her IT monitors from Year 7]

(Observation notes 23rd Jan)

When asked about her use of children to peer tutor Mrs Henry reported that she tended not to rely on them to help each other with the software:

> Sometimes I do use children, but as I say, because their experiences are so patchy right now, I don't have many who I feel confident can teach themselves
>
> (Mrs Henry, 21st Jan)

This view that she didn't use the children because she thought they lacked the necessary knowledge and skills tied in with her view of herself as a co-learner alongside the children rather than 'the expert'. Her questionnaire responses indicated that, whilst she was more knowledgeable than the children were, she was happy to reveal to them any uncertainties and weaknesses she might have in terms of knowledge, skills and understanding. The only corroborating evidence for this that came to light during the research was on one occasion when a child spotted an error in the work Mrs Henry had put up on the whiteboard. When she drew this to Mrs Henry's attention she was told to correct it.

> 2.31 Mrs Henry helping Janetta – no – Janetta has pointed out to Mrs Henry that she (Mrs Henry) has got the apparatus and method the wrong way round on the board.
> Janetta rubs it out on board and starts to correct it.
> Anna jumps out and helps her (Jannetta's writing is not as neat as Anna's). Rest of class protest and Mrs Henry explains that Janetta has spotted this mistake and is putting it right.
> (Observation notes 23rd Jan)

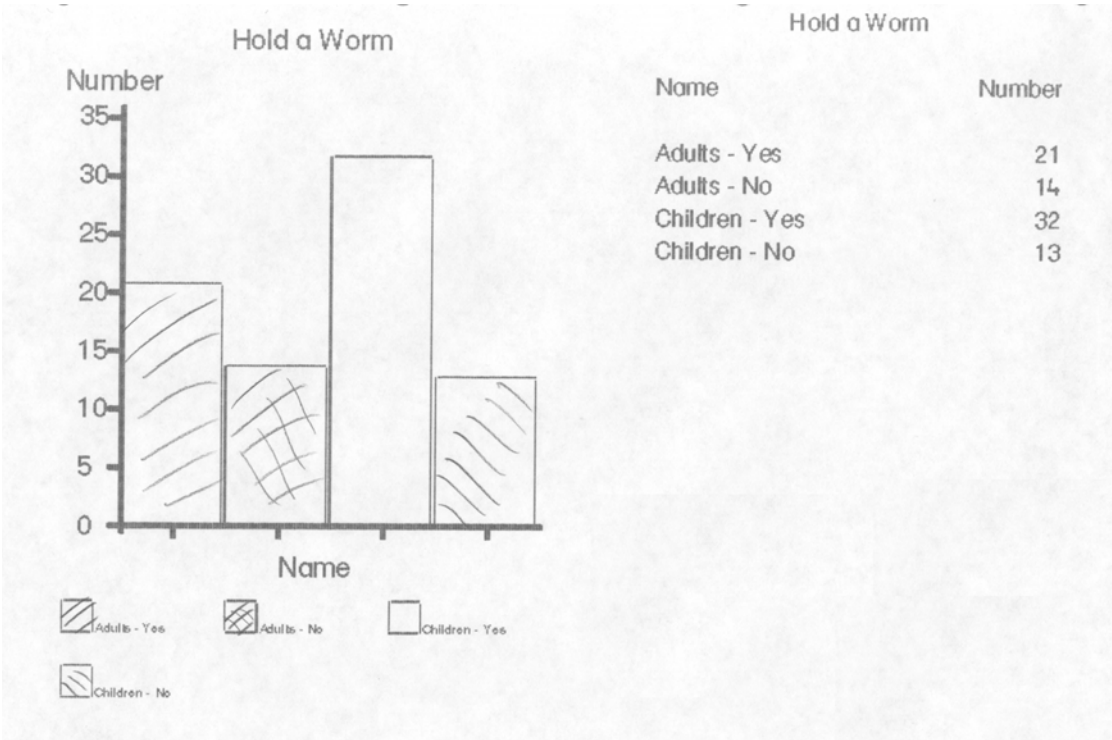
Organisation of computer use

The way in which computer use was organised within 6TH fell into one of five basic patterns. The first three of these involved children from the whole class and included: a pair of children or an individual working on the Acorn; the whole class working in pairs using the school's set of PocketBooks; Mrs Henry (or Mrs Green) demonstrating some new software to a group or the whole class. The last two patterns were restricted to the SEN children, and included: the SEN twins taking turns to learn to touch type using the Acorn, whilst the rest of the children were in assembly; and Adam using the Pocketbook to word process text whilst the other children were writing by hand. This last arrangement often concluded with Mrs Henry acting as a scribe for Adam (e.g. English and Science during Week 3).

The use by the SEN children was noticeably different to the use by the rest of the class in that it involved much higher levels of adult involvement. The usual pattern for the non-SEN children was for an adult to introduce a new program and then for pairs of children to use it with minimal adult involvement. The introduction of Graphplot in Week 3 followed this pattern. Mrs Green demonstrated the software to her group on the Tuesday morning

(Observation 20th Jan). Children from her group then entered their own data and plotted a graph (see Figure 6.7 for an example) during subsequent maths sessions (Observation 23rd Jan).

Figure 6.7 Example of a graph produced by a pair of children from Mrs Green's maths group in 6TH



Monty had followed a similar pattern; having been introduced to the whole class by Mrs Henry the previous term, it seemed to be a well established part of the maths sessions during the first two weeks of the spring term. In contrast to this pattern of use, the data logging activity was organised as a series of demonstrations, which were not followed up by hands on use by the children, as evidenced by this extract from an interview:

Mrs Henry	They didn't actually do it themselves, I supervised …
Researcher	OK. But they experienced it and saw how it worked.
Mrs Henry	Then because they found that there were two winners, the next day we set it up again out there, where they could just go and have a look at it from time to time, and we just left it running all day, for the two winners to see which one was the overall winner.
Researcher	Right, OK.
Mrs Henry	So they haven't set it up themselves, but they've experienced it.

(Interview 21st Jan)

The emphasis on pairs of children appeared to be a pragmatic one, linked more to organisational constraints than anything else. Thus, for example, the children worked in pairs when the whole class was using the PocketBooks, as there were not enough to have one each.

> They'll do it in pairs, 'cos I'm only using the 20 [PocketBooks] so far. I'm not using the new ones yet, because they haven't been security-coded yet. So they have to do it in pairs, and that …
>
> (Mrs Henry, 21st Jan)

On the occasions when the children worked individually on the computers (with the exception of Adam) it again appeared to be for pragmatic reasons:

Researcher	Rich was doing it [Monty] on his own, I think it was Rich …
Mrs Henry	because I have an odd number of children.

(Interview 21st Jan)

Mrs Henry identified that her three main criteria for selecting children to work together using the computer were age, needing to develop the same skills, or selection from an alphabetical list. She occasionally used other criteria for selecting group members including: friendship; interest; gender; culture; or simply who happened to be free at a particular time (Questionnaire 6th Feb).

When the children were grouped together on the computer they worked in a range of different ways, including working in parallel, co-operatively and collaboratively. Mrs Henry said that she thought that she balanced the children's work fairly evenly between these different ways of working when in groups (Questionnaire 6th Feb). During the first half of the spring term a range of ways of working were recorded. For example, when the class used the set of Pocketbooks to look at time zones they worked in parallel; each pair of children took turns to use their shared PocketBook and the whole class were doing the same activity. A second way of working that was observed involved a boy and girl using Monty who were clearly collaborating; while one controlled the mouse the other controlled the keyboard (they swapped over part way through), and they were both focussing on the screen, pointing at it and talking to each other (Observation notes 20th Jan). Another example that was observed involved children who were using Graphplot. They appeared to be collaborating, in that they were taking turns to read out or enter data (Observation notes 22nd Jan).

Recording of computer use

Mrs Henry reported that she spent approximately 40 minutes per term recording the children's progress on computer related activities. Her recording system consisted of a mark book with the children's names down one side and columns in which she could mark off each time a child had undertaken a particular IT activity, as illustrated in Table 6.13. The IT records were spread across a number of pages within this book, with one or two IT activities per page, alongside activities in other subjects.

Table 6.13 Illustrative example of Mrs Henry's IT records

	IT				
	Monty		**Logo**		**Spreadshet**
Child 1's name	II				
Child 2's name	II				
Child 3's name	II				
Etc for whole class	I				

Description of the practice surrounding computer use based on the Computer Practice Framework

The researcher made a holistic judgement about the computer use in 6TH on the basis of his observations in the class and other data collected (Table 6.14).

Table 6.14 The researcher's holistic judgement of the computer use in 6HT based on the CPF

Quantity		Focus			Mode		
Rating	**%**	**Category**	**Rating**	**%**	**Category**	**Rating**	**%**
Some	20%	Pragmatic	Some	20	Repetition	Some	60
		Computing	Some	30	Replacement	Some	30
		Learning	Some	40	Extension	Some	10

The teacher was asked to rate her classes' computer use against the CPF in the Teacher Questionnaire (see Appendix D). Her responses are summarised in Table 6.15.

Table 6.15 Mrs Henry's holistic judgement of the computer use in 6HT based on the CPF

Quantity		Focus			Mode		
Rating	**%**	**Category**	**Rating**	**%**	**Category**	**Rating**	**%**
Some	10 - 30	Pragmatic	Some	11 - 30	Repetition	QaL	31 - 70
		Computing	QaL	31 - 70	Replacement	None	0 - 10
		Learning	Some	11 - 30	Extension	Some	11 - 30

Each of the activities in Week 3 were rated against the CPF, on the basis of the available evidence. Table 6.16 shows an example of the analysis of one activity (see Appendix G for full details of this analysis).

Table 6.16 An example of the analysis of one activity using the CPF

23rd Jan	**Adam writing answers to comprehension exercise on Pocketbook during English**			
Quantity	Manual Log: 45 minutes (45/300)			
	%	15%		
Focus	This activity was an integral part of the English lesson. Other children in the class were doing the same exercise on paper. The aim of the computer use seemed to be to enable Adam to complete the activity, both by speeding up his writing and by helping to maintain his interest/focus on the task. Using the Pocketbook helped to maintain Adam's interest/focus on the task and resulted in his being less disruptive/demanding. The quality of the final printout was also intended to overcome the stigma attached to Adam's handwritten work. Adam had used the PocketBook in this way many times before, so was familiar with how the software worked. Whilst he did know how to print out he needed help in connecting up his PocketBook to the printer.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%	30%	10%	60%
Mode	This was an activity that all the other children were doing without the use of ICT, which would suggest it fell within the Replacement category, as Adam was doing it on the computer rather than by hand. However, Adam would not have been able to complete the activity within the lesson had it not been for the use of the computer. In that sense it extended what he was able to do.			
	Category	**Repetition**	**Replacement**	**Extension**
	%		50	50

These individual descriptions for each activity were weighted on the basis of the number of children who had been involved in the activity and the length of time it had lasted (see

Appendix G). These weighted ratings were then combined to establish the weighted rating each day for the computer use in 5SL against each of the dimensions of the CPF (see Appendix G). These daily ratings were then averaged to give an overall rating of the computer use in 6TH against each of the dimensions of the CPF (Table 6.17).

Table 6.17 Holistic rating for the computer use in 6TH based on an analysis of the individual activities in Week 3

Quantity		Focus			Mode		
Rating	**%**	**Category**	**Rating**	**%**	**Category**	**Rating**	**%**
Some	23	Pragmatic	Some	14	Repetition	Lots	85
		Computing	QaL	57	Replacement	Some	13
		Learning	Some	29	Extension	None	2

Comparison of Case Studies 4 and 5

Case Studies 4 and 5 were designed to provide further evidence about the extent to which the CPF met the criteria for evaluating frameworks for describing computer use in education. This analysis was based around those evaluation criteria. Particular attention was paid to the criteria that the initial evaluation of the CPF had not been able to address adequately. These included: *overlap*; *relativity*; *discrimination and accuracy*; *adequacy and currency*; *ambiguity*; and *ease of use*. As already indicated, the question of *cultural specificity* was not addressed by these case studies. A separate investigation was set up to explore this issue, based on the use of the CPF in UK higher education. This is described in the next section of this chapter.

Overlap

In applying the CPF it rapidly became clear that there was some confusion between two of the categories of the Mode dimension. There were times when it was not obvious whether an activity should fall into the Repetition or Replacement categories. For example, when the children were generating graphs using GraphPlot in 5SL they were clearly doing something that they knew how to do by hand and on the computer. They were also doing it on the computer rather than doing it by hand. Thus the Mode suffered from the problem of overlap: the same computer use appeared to fall into both categories simultaneously. In order to overcome this problem the definitions of these two categories were refined, as shown in Table 6.18.

Table 6.18 Revised definitions of Repetition and Replacement

Mode **How the computer is actually used**	
Category	**New definition**
Repetition	Where the computer is being used to repeat something which the user already knows/understands/can do (either on or off the computer).
Replacement	Where the computer is being used to do something which the user has not done before (either on or off the computer) but which could have been done without a computer.

Relativity

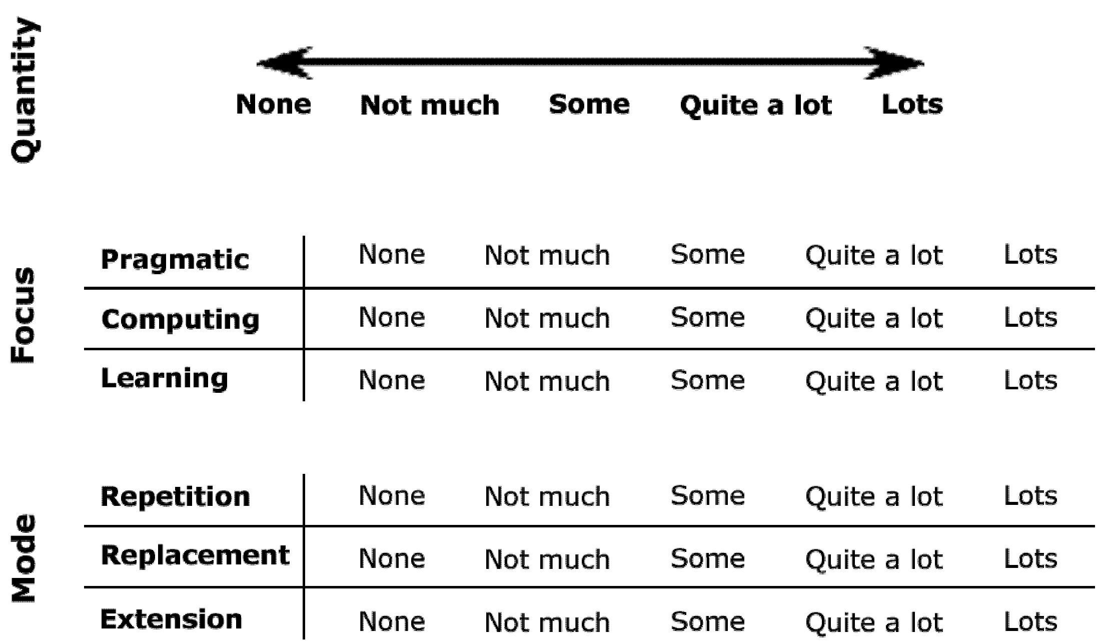
The need to test the meanings that people attached to the relative terms used within the CPF was explicitly addressed in the two case studies by asking the teachers to identify what they considered the range of reasonable interpretations of each term to be. The results of this, which are shown in Table 6.19, highlighted a number of issues.

Table 6.19 Comparison of the ranges specified by Mrs Light and Mrs Henry

	Range **(Minimum - Maximum mins per day)**	
Quantity	**Mrs Light (CS4)**	**Mrs Henry (CS5)**
None	0 - 0	0 - 0
Some	1 - 30	30 - 90
Quite a Lot	31 - 60	91 - 180
Lots	60+	180 – All the time
	Range **(Minimum – Maximum % to which it applies)**	
Focus and Mode	**Mrs Light (CS4)**	**Mrs Henry (CS5)**
None	0 – 25	0 - 10
Some	26 – 50	11 - 30
Quite a Lot	51 – 75	31 - 70
Lots	76 - 100	71 - 100

Firstly, it was clear that there was a problem at the bottom end of the Quantity range. Whilst both teachers viewed 'None' as meaning literally 0 minutes computer use per day, Mrs Henry had completely omitted the possibility of describing 1 to 29 minutes use per day. In addition, both teachers described the quantity of computer use in their classrooms as being 'Some', but they had very different definitions of this term. From this, and the fact that in the vast majority of classes the quantity of computer use fell at the lower end of this dimension, it became clear that an additional category needed to be added to the scale. Thus, the descriptor 'Not much' was added to the Quantity dimension. In order to maintain consistency between the three dimensions of the CPF this descriptor was also added for the Focus and Mode dimensions, as shown in Figure 6.8.

Figure 6.8 The revised dimensions with 'Not Much' added



The second issue related to the lack of agreement in the ranges from these two teachers. Mrs Henry clearly had a very different view to Mrs Light about how much computer use ought to be taking place, which was reflected in the differences between their definitions of the minimum and maximum ranges for each of the fuzzy descriptors on the Quantity dimensions. The differences were not so extreme in relation to the Focus and Mode dimensions. It was hoped that the inclusion of an additional descriptor would help to overcome these differences, but further work on the interpretation of the fuzzy descriptors was needed, particularly in relation to the Quantity of computer use. It was planned to incorporate this as part of the research looking at the use of the CPF within higher education, which is described later in this chapter.

Discrimination and *Accuracy*

Two different aspects of Accuracy were explored. These related to the consistency of the descriptions provided by the CPF and the extent to which those descriptions fitted the rich descriptions of the computer use in each of the case studies. These different aspects of Accuracy correspond to the notions of reliability and validity respectively.

Closely linked with the issue of validity was the extent to which the descriptions based on the CPF discriminated between differences in computer use that had been identified by the rich descriptions of computer use, for each of the case studies in isolation. The final aspect of discrimination that was addressed was the extent to which the descriptions based on the CPF discriminated between significant differences between the two case studies.

Reliability

For each of the case studies three different descriptions based on the CPF were produced, as noted on p.243. Comparing these three descriptions for each case study separately revealed a lack of consistency across them. Tables 6.20 and 6.21 show that whilst there were some agreements between pairs of descriptions for some dimensions there was no consistent pattern in this. For example, the researcher's holistic judgements of Quantity and Focus were very similar to those gained from analysis of the individual activities within Case Study 4. However, the researcher's holistic judgements of Focus in Case Study 5 was different to that gained from analysis of the individual activities. In the case of the Mode dimension, the rank ordering of the three sub-dimensions was similar for the Researcher and the analysis of the individual activities, but the actual percentages varied quite substantially.

Table 6.20 Comparison of the CPF descriptions for Case Study 4

	Researcher	Teacher	Individual activities
Quantity	15%	<1 to 10%	17%
Focus			
Pragmatic	30%	26-50%	28%
Computing	50%	26-50%	51%
Learning	20%	26-50%	21%
Mode			
Repetition	60%	26-50%	94%
Replacement	20%	0 to 25%	0%
Extension	20%	26-50%	6%

Table 6.21 Comparison of the CPF descriptions for Case Study 5

	Researcher	Teacher	Individual activities
Quantity	20%	10 to 30%	23%
Focus			
Pragmatic	20%	11 to 30%	14%
Computing	30%	31 to 70%	57%
Learning	40%	11 to 30%	29%
Mode			
Repetition	60%	31 to 70%	85%
Replacement	30%	0 to 10%	13%
Extension	10%	11 to 30%	2%

This suggested that the descriptions of the CPF were not reliable across raters or rating methods. This might have been due to ambiguity in the definitions of the dimensions or in the way in which they were applied. However, whatever the underlying cause of this inconsistency between the different descriptions, further work was clearly needed to explore this more fully with a larger number of raters all applying the same approach. This work, which is identified in Table 2.8 (p.61) as Cycle 3, is described in the next chapter.

Validity

Validity and reliability are intimately linked. Thus, the apparent lack of reliability of the descriptions based on the CPF called their validity into question. None the less a comparison between the Researcher's holistic judgements based on the CPF with the researcher's rich descriptions of the computer use in each case study was carried out. This was in part because in the process of applying the CPF some issues about the definition of the Mode dimension had arisen, which needed further exploration

The comparison between the descriptions of Case Study 4 (see Table 6.22) seemed to suggest a good fit between the rich description and that based on the CPF, although there were clearly details included in the rich description that were subsumed within the CPF ratings. The amount of computer use was very similar for both descriptions. Both descriptions seemed to agree that the main Focus was on learning about IT, with some use to support learning in other areas. Both descriptions identified a pragmatic element to the computer use, though this came across more strongly in the CPF description. Both descriptions seemed to agree that there was little impact on the curriculum and that the predominant mode of computer use was repetition (e.g. copy typing).

Table 6.22 Comparison of the descriptions of Case Study 4

	Key issues from rich descriptions	CPF description
Quantity	< 50 minutes per day (<17%)	15%
Focus	More computer use when researcher present than at other times. Specific IT slots plus integration into other subjects. Use of Adventure games linked to topic – focus on using IT to support learning in other areas. Use of generic tools, mainly to gain IT skills but small amount of use to enhance work in other areas. Nearly all adult involvement in computer use was focused on IT skills and management issues.	**Pragmatic** 30% **Computing** 50% **Learning** 20%
Mode	Predominant use of PocketBooks for copy typing. Little or no impact on curriculum. Limited evidence of genuine collaboration, except in context of using the adventure game.	**Repetition** 60% **Replacement** 20% **Extension** 20%
Other	Teacher's overall approach was fairly 'progressive'. Fairly fluid arrangement of computer time. Little teacher involvement in computer use. Children helping each other (as was the case in other contexts within the class too). Mostly working in pairs, though this often concealed individual working (turn taking). The potential for future plans to alter impact on the curriculum, through use of Magpie for example.	Not directly covered by CPF though may be linked with dimensions. Eg Children helping each other may link with Extension (as was the case in Case Study 1)

However, the rich description for Case Study 4 raised issues about the definition of the Extension category. It was clear from the rich description that part of the reason that Mrs Light did not think that computer use had impacted on the curriculum was because her practice was already quite progressive. This was reflected in her enthusiasm for authentic learning (e.g. Rainforest Café, links with external organisations, raising money to buy/protect Brazilian rainforest), thinking about real audiences, and encouraging children to work together and support each other. This meant that the children helping each other on the computers did not represent a change in 5SL's practice, as it clearly had been in Case Study 1 for example. What this suggested was the need for a baseline of what 'normal' practice would look like, against which the practice surrounding computer use could be compared.

The comparison of the two descriptions for Case Study 5 also suggested a good match in terms of the amount of computer use (Table 6.23). However the match in terms of the other dimensions was not as close. For example, the CPF description suggested that there had been a greater emphasis on using computers to enhance learning than on learning about IT itself than the rich description. This discrepancy appeared to be linked to the issue of reliability as the other CPF descriptions (Table 6.21) matched the rich description more closely in this regard.

Table 6.23 Comparison of the descriptions of Case Study 5

	Key issues from rich descriptions	**CPF description**
Quantity	60 minutes per day (20%)	20%
Focus	SEN children – IT skills and supporting learning in other areas Close integration of IT with other subjects – but little impact on curriculum, emphasis more on giving children exposure to ICT.	**Pragmatic** 20% **Computing** 30% **Learning** 40%
Mode	Little if any impact on curriculum, except in case of SEN child who was sometimes empowered to do things that he could not have achieved (in the same timescale or perhaps at all) without the technology. Use of Monty to explore number patterns and tables. Little use of children for peer tutoring.	**Repetition** 60% **Replacement** 30% **Extension** 10%
Other	Mrs Henry spent around 20 mins per day on average supporting children using the computer, though much of this focused on supporting the SEN child. Mrs Henry was fairly traditional teacher (eg limited range of audiences, firm control over all aspects of class activity). However, range of ways of working including collaboration (eg when using Monty).	Not directly covered by CPF though may be linked with dimensions.

The rich description of Case Study 5 raised issues about the Mode dimension, both in relation to the SEN child and the proposed use of Magpie. In the case of the SEN child it was clear that the teacher had recognised the potential of the PocketBook to allow him to undertake the same activities as other children in the class. This was something that Mrs Henry clearly saw as being desirable, which the PocketBook then made achievable. In the case of Magpie, the use of the computer was going to give the children access to a whole new way of representing information, using hypermedia. This was something that not only would not have been possible without IT, but also would not have been contemplated. In some sense the existence of the technology in this latter case changed what the teacher considered to be valuable. This led to the Mode dimension being altered, as summarised in Table 6.24.

Table 6.24 Summary of changes to the Mode dimensions resulting from Case Study 5

Mode How the computer is actually used		
CPF v4 Category	**New Category**	**New definition**
None	None	Quantity of computer use is 'None'
Repetition	Repetition	Where the computer is being used to repeat something which the user already knows/understands/can do (either on or off the computer).
Replacement	Replacement	Where the computer is being used to do something which the user has not done before (either on or off the computer) but which could have been done without a computer.
Extension	Extension	The activity on the computer enables you to do something which extends the curriculum or pedagogy, but which would have been seen as being valuable without a computer (but would not have been practically possible without a computer)
	Transformation	The activity on the computer enables you to do something which extends the curriculum or pedagogy that you could not and/or would not have done if it were not for computers.

The apparent lack of reliability of the CPF descriptions had a direct bearing on any consideration of the extent to which they discriminated between cases. If the descriptions were not reliable then any conclusion about their ability to discriminate would not be valid. Thus, further consideration of this issue was postponed until further work on the reliability of the CPF had been undertaken.

Adequacy, *Currency*, *Ambiguity* and *Ease of Use*

The definitions of the dimensions of the CPF were able to cope with all of the computer use within Case Studies 4 and 5, and with their proposed future use of multimedia authoring software. Thus, it met the *adequacy* and *currency* criteria.

Discussion with the two teachers suggested that the terms used on the Focus dimensions were a little confusing. They both disliked the term Pragmatic, which they thought had negative connotations. They also thought that 'Learning' was problematic as it suggested that a focus on 'Computing' did not involve learning. They also felt that the term Computing would be better if replaced by 'IT'. As a consequence, and in order to overcome this problem of *ambiguity*, all the terms used to describe the categories on the Focus dimension were changed, as indicated in Table 6.25. The distinction between IT, as the subject, and ICT as using computers as a cross curricular tool had recently been made by the QCA (QCA and DfEE 1998). This therefore seemed an appropriate way to label the Computing and Learning categories.

Table 6.25 Summary of changes to the Focus dimensions resulting from Case Studies 4 and 5

Focus **Reasons why you are using a computer with your children**		
CPF v4 Category	**New Category**	**New definition**
Computing	IT	Using computers in order to learn about computers
Learning	ICT	Using computers as tools to help children learn about something else
Pragmatic	Other	Using the computer for some other reason
None	N/A	Quantity of computer use is 'None'

It was clear that applying the CPF holistically was quick and easy to do. Applying the CPF by analysing each activity and then weighting them was much more time consuming. However in both cases the process was significantly easier than doing the analysis on the basis of the key dimensions of practice that was used to generate the rich descriptions of each case study (see Table 6.3 on page 243). This suggested that the CPF did meet the *ease of use* criterion.

Using the Computer Practice Framework in UK higher education

In order to investigate the extent to which the CPF suffered from Cultural specificity it was decided to explore its use in higher education. Initially a survey of staff involved in using computers in teaching in higher education was planned, as explained in Chapter 2 (p.63). A questionnaire was therefore designed that could be completed by staff in higher education institutions (see Appendix H for the final version of the questionnaire). Due to very low return rates for this questionnaire it was not possible to carry out any quantitative analysis. None the less, the process of developing the questionnaire and obtaining responses to it from a handful of colleagues proved informative in two ways.

Firstly, the responses from the small sample (n=6) of academics working in a range of different subjects and institutions suggested that the CPF did apply in the context of higher education, as well as in schools. Indeed, one of the respondents added a comment to his questionnaire that not only suggested that this was the case but also indicated that the CPF had *Generative* potential:

> Again, some useful distinctions here. I think that both 3 and 4 [The Focus and Mode dimensions] would be useful for getting colleagues to reflect on their courses.
>
> (Quote from a respondent's questionnaire, text in square brackets added)

Despite this it was clear that there were problems relating to cultural specificity, in relation to the interpretation of the fuzzy terms, particularly in connection with the Quantity of computer use. The responses about the quantity of computer use ranged from 'None' to 50 hours per week. Thus, the potential maximum quantity of computer use within higher education appeared to be considerably higher than that within primary schools. This meant that it would not be possible to use the CPF to make comparisons across these two contexts.

In order to investigate this further, a questionnaire was circulated to colleagues on the Association for IT in Teacher Education (ITTE) mail list asking them to give their interpretations of the minimum and maximum values that could reasonably be applied to the categories on the Quantity dimension. Again the number of responses was small (n=7), but they confirmed that the interpretation of these terms would be very different in primary schools and higher education institutions. Respondents to the ITTE questionnaire also made comments that indicated that the way in which the categories on the Quantity dimension were interpreted would be likely to vary between schools and across time. Generally the respondents to the ITTE questionnaire thought that the use of fuzzy descriptors was too complex. They also raised questions about the extent to which the number of children sharing a computer was important, or whether computer use would include use by the teacher during a whole class lesson.

This led to a move away from the use of fuzzy descriptors, both in order to simplify the CPF, and to take into account problems of different and potentially changing interpretations of such descriptors. Furthermore, the definition of the Quantity dimension was clarified in order to overcome ambiguity about what counted as pupils/students using a computer. These changes are described in the next section, along with the changes made in the light of the full analysis of Case Studies 4 and 5.

Summary of modifications to the Computer Practice Framework

Case Studies 4 and 5 and the feedback from colleagues in higher education led to a number of important changes in the CPF. This constituted the last stage of Cycle 2 in Table 2.8, and resulted in the version of the CPF that is described below, in the form that they were presented to teachers.

The Quantity dimension

The Quantity of computer use is a measure of how much of the school day one or more computers are in use by children from your class. Within this definition, the school day is taken to mean time when children are in school but excluding play times, lunch times, after school clubs etc. The number of children using a computer is irrelevant (for this indicator), as is the number of computers in use. If a computer is being used with children, even if they are not controlling the keys/mouse, that counts as it being used by the children.

The Focus dimension

The Focus deals with the reasons why you use a computer with your children.

The Focus dimension does not apply if you are not using computers with your children (i.e. if the Quantity of computer use is 0%).

The Focus dimension is divided into three categories:

IT - Using computers in order to *learn about computers.* Thus the focus here is on using a computer in order to extend the children's knowledge, understanding or skill in computer use.

E.g. Using the computer in order to learn how to operate the mouse.

E.g. Using the computer in order to learn how to use the word processing software.

ICT - Using computers as tools to help children *learn about something else*.

E.g. To help them develop the language skills involved in drafting and re-drafting.

E.g. To extend their ability to interpret graphs (i.e. mathematics).

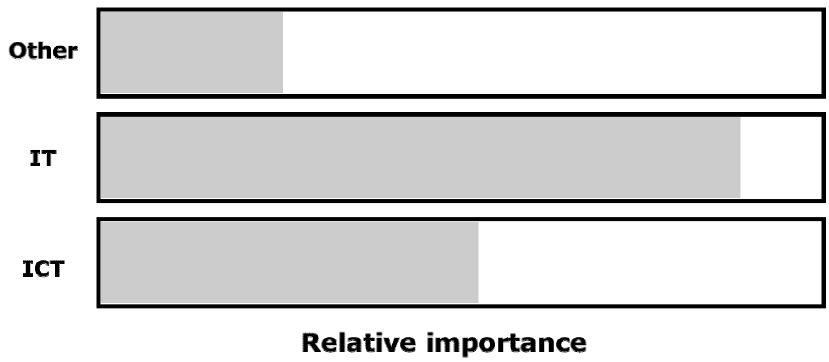
Other - Using the computer for *some other reason*. Reasons for using computers that fall within this category are not focused on learning but on some other aspect of the classroom situation.

E.g. Using IT in order to be seen to be using it.

E.g. Allowing children to use the computer as a reward or filler activity.

All three categories on the Focus dimensions may apply at any one time. The key is to identify the relative importance of each category. Figure 6.9 illustrates how this might be represented visually.

Figure 6.9 A visual representation of the relative importance of each category on the Focus dimension



The Mode dimension

The Mode looks at how computers are used in your class. The Mode dimension does not apply if you are not using computers with your children (i.e. if the Quantity of computer use is 0%).

The Mode dimension is divided into four categories:

Repetition - where the computer is being used to repeat something which the students already 'know/understand/can do' (either on or off the computer). i.e. The students are repeating an activity that they have done before (though the context previously may not have been on the computer).

E.g. Generating graphical representations of data when the students already know how to draw such representations by hand.

E.g. Generating graphical representations of data when the students have already learnt how to draw such representations on the computer (even if they do not know how to draw them by hand).

Replacement - where the computer is being used to do something which the students have not done before (either on or off the computer) and which could have been done without a computer.

E.g. Learning how to carry out a statistical analysis on the computer (when they have never learnt how to do this before either on or off the computer).

Extension – where the computer is being used to do something which extends the curriculum or pedagogy within the classroom but which would have been seen as being valuable without computers. i.e. you are doing something that would not have been practically possible within the classroom without a computer but which would have been valued as part of practice if it were possible.

E.g. Writing for a real audience in another country (using email).

E.g. Having an ongoing discussion with remote experts (via computer conferencing).

E.g. Using a simulation to explore 'being' a racing driver or an underwater archaeologist.

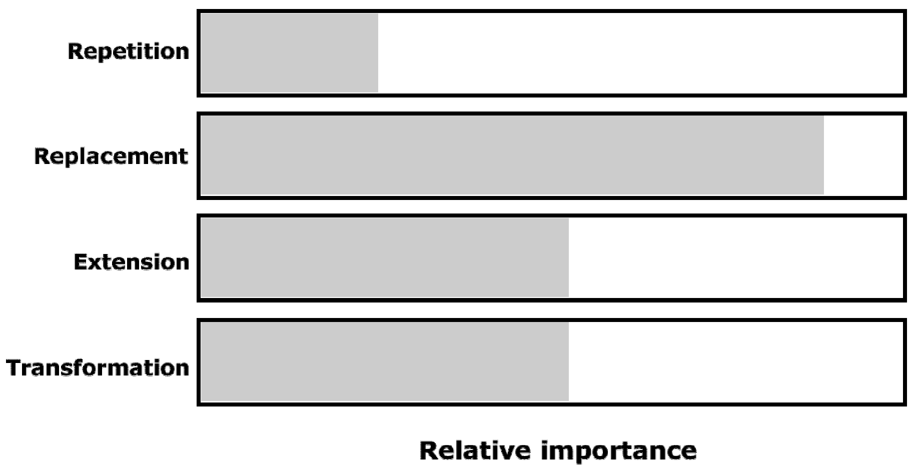
Transformation – where the computer is transforming the curriculum or pedagogy. i.e. you are doing something that extends the curriculum and/or pedagogy that you could not and/or would not have done if it were not for computers.

E.g. Increasing the literacy skills that children deal with to include understanding multimedia 'texts'.

E.g. Explicitly teaching the children how to teach each other (if this is something that you would not have previously done in any other context).

Whilst for any one activity one Mode is likely to predominate, over a series of activities all four categories on the Mode dimensions may apply to some degree. The key is to identify the relative importance of each category. Figure 6.10 illustrates how this might be represented visually.

Figure 6.10 A visual representation of the relative occurrence of each category on the Mode dimension



Conclusion

It was clear from the fieldwork described in this chapter that there were still some problems with the CPF, particularly in terms of its validity and reliability. Furthermore, following Case Studies 4 and 5 and the small scale surveys of academics in higher education a number of important modifications had been made to the CPF. These included moving away from the use of fuzzy terms for all three dimensions, as well as adding a category to the Mode dimension. The names of all the categories on the Focus dimension were also changed, as were some of those on the Mode dimension. These changes need to be tested further to see whether they had enhanced the CPF in relation to the evaluation criteria. Even more importantly, the reliability of the CPF needed to be tested more thoroughly. Thus, the research moved into the third 'action research cycle' identified in Table 2.8 (p.61), which is the focus of the next chapter.

Chapter 7
Refocusing the Computer Practice Framework

Introduction

The need to further investigate the reliability and validity of the CPF was highlighted by the analysis of the data from Case Studies 4 and 5. The changes made to the CPF in the light of fieldwork described in the previous chapter also necessitated further evaluation of the framework. This represented the beginning of Cycle 3, as identified in Table 2.8. It was planned to accomplish this through Case Study 6, which had been planned as a follow up to the same teacher as in Case Study 4.

In order to test the reliability of the CPF one more case study seemed likely to be inadequate. In addition, prior experience of using the CPF had shown that input from colleagues led to suggestions for improvements to the framework. A three stage process for testing the CPF, with a particular focus on its reliability was therefore planned (see Table 7.1).

Table 7.1 Three stage process for testing the CPF, corresponding to the Action Steps from Cycle 3 (see Table 2.8 on p.61)

Cycle 3 Action Step	Stage	
1	1	Focus group at the ITTE conference to consider CPF
2	2	Case Study 6
3	3	Explore inter-operator reliability, using data from Case Study 6

The ITTE Focus Group

The focus group was held as part of the annual ITTE conference in 1999. Ten people, all of whom were involved in teacher education and ICT attended this one hour long session. During the session they were presented with information about the CPF, including handouts which provided definitions of the CPF and how it linked with other dimensions of practice (see Appendix I). The discussion focussed on the CPF, and respondents were provided with a response sheet to fill in at the end of the session (see Appendix J).

Data analysis and changes to the Computer Practice Framework

The verbal feedback from the session (n = 10) and the written feedback to the response sheets (n = 5) were then analysed separately for each dimension of the CPF. The written responses closely mirrored the verbal discussion. Given the small number of people involved (10 and 5) statistical analysis was inappropriate.

Quantity

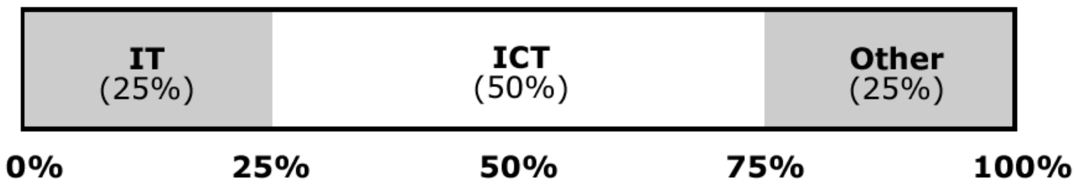
Whilst all of the respondents felt that they understood the Quantity dimension there was some concern about how easy it would be to use in practice and about the degree of precision involved. For example, several respondents felt that the number of children using a computer at one time and/or the number of computers being used were important issues. There was also confusion about how the averaging of the quantity of computer use should be done given the large degree of variability in the amount of use over time. These concerns tied in with the original thinking underpinning the development of this dimension discussed in Chapter 6. One respondent thought that given the generally low level of computer use in schools it would be easier to estimate the average amount of time during which computers were not in use.

This feedback did not lead to any changes in the Quantity dimension itself, but did lead to clearer guidance being provided in the future about the period of time over which the quantity of use should be averaged.

Focus

All of the respondents said that they understood the Focus dimension. However, it was clear from both the discussion and the comments on the questionnaires that the definition and the way it was being represented visually were not being interpreted in the way that had been intended. For example, one respondent wanted the diagram (Figure 6.9 on p.298) to be altered so that it showed 0-100% and that the order of the categories on the diagram should be the same as the order in the verbal definition. This indicated a lack of understanding of that diagram and what it represented, but suggested how it could be improved to enhance the clarity of the representation of the Focus dimension as shown in Figure 7.1.

Figure 7.1 Refined representation of the Focus dimension



Another common concern expressed during the discussion and in the written responses was that the definition of the categories on the focus dimension seemed to imply a limited view of learning as being concerned simply with knowledge acquisition. This linked primarily with the use of the phrase 'learning about something else'. The respondents felt that this excluded other facets of learning, including developing understanding and skills. A number of other possible reasons for using computers were also raised, which people either felt were not covered by the definition of the Focus dimension or that it was unclear which category they belonged to. These included: to develop self-esteem; to encourage collaboration; to extend learning for high achievers; and to overcome disability.

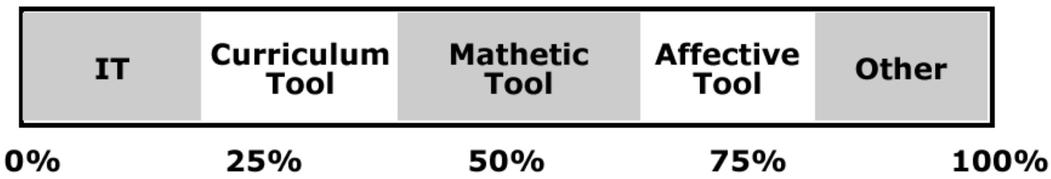
Whilst these were all already subsumed under the ICT category it was clear from the feedback that this was not adequate. The Focus dimension was therefore refined to explicitly acknowledge these other aspects of learning. This involved splitting the ICT category in to three separate categories: Curriculum Tool; Mathetic Tool; and Affective Tool (as defined in Table 7.2).

Table 7.2 Definitions of the categories on the Focus dimension, as presented to teachers

Previous Category	New Category	New definition
IT	IT	Using computers in order to help children to develop their IT skills, knowledge and understanding. The emphasis here is on using a computer in order to extend the children's knowledge, understanding or skill in computer use itself.
ICT	Curriculum Tool	Using computers as tools to help children to develop skills, knowledge and understanding in another curriculum area. The emphasis here is on using the computer as a tool to enhance their learning in another curriculum area rather than in the area of IT itself.
	Mathetic Tool	Using computers as tools to develop children's ability to learn and enhance their approaches to learning.
	Affective Tool	Using computers as tools to support and enhance the affective aspects of children's learning.
Other	Other	Using the computer for some other reason. Reasons for using computers that fall within this category may be focussed on practical aspects of the learning situation or the larger context in which the computer use is taking place.

The visual representation of the Focus dimensions was also updated to reflect these changes (Figure 7.2).

Figure 7.2 Representation of the revised Focus dimension



Mode

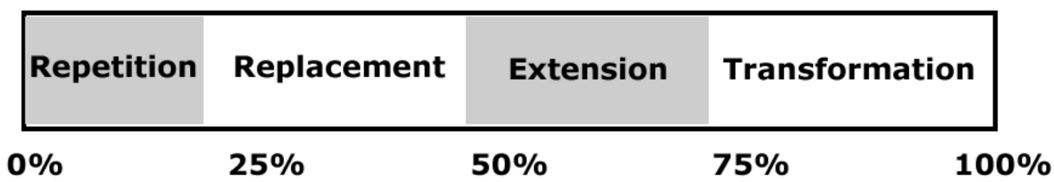
Whilst the majority of the respondents said they understood the Mode dimension this was not unanimous, as it had been for the Quantity and Focus. Several people commented on the complexity of the Mode and the time it had taken them to understand it. This related primarily to the distinction between the Extend and Transform categories. They all thought that the exemplification provided had been very helpful, but also that the length of the definition, including exemplification, was problematic. One of the respondents was not convinced that all the examples of Transformation that were provided actually fitted the definition. This feedback led to a redefinition of the Extension and Transformation categories, as shown in Table 7.3.

Table 7.3 Definitions of the categories on the Mode dimension, as presented to teachers

Category	New definition
Repetition	Where the computer is being used to repeat something which the children already 'know/understand/can do' (either on or off the computer). i.e. The children are repeating an activity that they have done before (though the context previously may not have been on the computer).
Replacement	Where the computer is being used to do something which the children have not done before (either on or off the computer) and which could have been done without a computer.
Extension	Where the computer is being used to do something which extends the curriculum or pedagogy within the classroom. i.e. the teacher (or her children) is doing something that they **would not** have done if it were not for computers.
Transformation	Where the computer is transforming the curriculum or pedagogy. i.e. the teacher (or her children) is doing something that extends the curriculum and/or pedagogy that they **could not** have done if it were not for computers.

In the light of the feedback on the visual representation of Focus dimension the visual representation of the Mode dimension was also changed (Figure 7.3)

Figure 7.3 Revised representation of the revised Mode dimension



Conclusion

The outcome of the ITTE Focus Group was further refinement of the CPF, as described above. The feedback from the respondents had confirmed that further work was needed on the reliability and validity of the CPF.

Case Study 6

As shown in Table 6.1 (p.238), Case Study 6 was based in Brookdale and involved the same teacher as Case Study 4 (Mrs Light). Case Study 6 had two key aims. These were to provide evidence about the reliability and validity of the CPF and to collect 'raw data' that could be used in the subsequent testing of inter-operator reliability of the CPF. The same data collection techniques were used as in Case Studies 4 and 5 (see pp.239-241), with the exception that the Manual Logs were modified in order to focus attention on the dimensions of the CPF (see Appendix K). The schedule for data collection in Case Study 6 which was agreed with Mrs Light is set out in Table 7.4.

Table 7.4 Schedule for Data Collection in Case Study 6

Period of time (Week beginning) / **Data Collected**	3rd April	10th April	Easter Holidays	2nd May	8th May	15th May	22nd May to 26th June	3rd July	10th to 21st July
Background documentation	✓			✓	✓	✓	✓	✓	✓
Plans: medium term		✓		✓					
Plans: weekly				✓	✓	✓	✓	✓	✓
Plans: daily				✓	✓	✓	✓	✓	✓
Manual Logs				✓	✓	✓	✓	✓	✓
Records				✓	✓	✓	✓	✓	✓
Non-participant observation					✓		✓		
Photographs					✓		✓		
Informal interviews					✓		✓	✓	
Semi-structured Interviews							✓		

Data analysis

The data analysis focused on establishing the reliability and validity of the CPF as a framework for describing the practice surrounding the computer use in 4SL. The initial focus was on the reliability of the CPF. Five different descriptions of the computer use in 4SL were created, based on the CPF. As before these included holistic descriptions by the researcher and by Mrs Light. In addition three different weighted descriptions were produced, which took into account the number of children involved and the duration of each activity. These were: the researcher's weighted description based on his analysis of each instance of computer use that he saw; Mrs Light's weighted description based on her analysis of each instance of computer use seen by Researcher; and Mrs Light's weighted description based on her analysis of each instance of computer use during the term. These descriptions were compared to identify the degree to which they matched each other. There were two main aims for this analysis: to establish the extent to which the holistic descriptions were confirmed by the more detailed and time consuming weighted analyses; and to explore the degree of inter-operator reliability in the descriptions produced.

In the process of collecting the data about the Focus of computer use it soon became clear that subdividing this dimension into five separate categories caused two problems. Firstly, there was insufficient evidence in most instances to make clear distinctions between the relative weighting that applied to Curriculum Tool, Mathetic Tool and Affective Tool. Secondly, it made the Focus dimension too complex for the teacher (or others who might try to apply it). In order to overcome these problems the categories on the Focus dimension were modified so that there were three main categories, one of which was sub-divided into three (as shown in Table 7.5). The definitions of the categories/sub-categories remained unchanged.

Table 7.5 The simplified Focus dimension

Previous Category	New Category	Sub-categories
IT	IT	None
Curriculum Tool	Learning Tool	Curriculum Tool
Mathetic Tool		Mathetic Tool
Affective Tool		Affective Tool
Other	Other	None

In practice the relative importance of the sub-categories of Learning Tool was often ignored by the teacher, who simply provided a rating for the relative importance of the three main categories on the Focus dimension. This is reflected in the data analysis.

The analysis of the data from Case Study 6 was intended to start by exploring the issue of reliability and then move on to concentrate on the validity of the descriptions based on the CPF. However, for reasons that will become apparent this later analysis did not take place.

Description of changes to the case study school since 1998

Following on from Case Studies 4 and 5 the researcher provided Brookdale with the following equipment: 6 Psion 3c PocketBooks (2Mb), with three mains adapters; 3 Psion Parallel Printer Links; 1 Purple Software Psion 3.5" Disc Drive with mains adapter; and 3 Cannon BJC80 Colour Bubble Jet Printers with mains adapters. The equipment was designed to fit in with the school's existing resources, whilst maximising flexibility of use and minimising organisational problems. The parallel printer links allowed the PocketBooks to be connected to PCs so that material could be transferred between them. The disc drive was provided so that material on the PocketBooks could be saved on floppy discs, in order to: allow children to back up their work; help to alleviate problems associated with children having to always use the same PocketBook; and make the transfer of data to a PC much more straightforward. The printers were small and portable, so that they could be kept with the PocketBooks. They also had infrared ports so that work from the PocketBooks could be printed out without having to connect any wiring.

During the period between the end of Case Studies 4 and 5 and the start of Case Study 6 Mrs Henry, the teacher in Case Study 5 and the Brookdale's IT co-ordinator, emigrated to the USA. At this stage the head took over the role of IT co-ordinator. During the same period The National Literacy (NLS) and National Numeracy Strategies (NNS) were introduced and the revised National Curriculum was released. The NLS and NNS had had the overall effect in most schools of increasing the amount of the school day devoted to maths and English, often squeezing the other curriculum areas into the afternoon sessions. Both these strategies also placed a significant emphasis on whole class teaching. The introduction of the NLS would have placed an heavy additional workload burden on Mrs Light, who had become the English co-ordinator.

The government prioritised ICT during the period prior to Case Study 6, releasing substantial amounts of funding for new equipment (National Grid for Learning funding) and ICT INSET for teachers (NOF training). The NGfL funding helped Brookdale to invest significantly in the provision of additional ICT resources throughout the school.

Description of the case study classroom (4SL)

The Case Study 6 class (4SL) was a Y4 class (8 - 9 year olds) of 27 (17 girls and 10 boys). The class teacher (Mrs Light) held the post of responsibility for English within the school. During the Summer Term, when Case Study 6 took place, 4SL had access to a variety of desktop computers, including: four computers in the shared area directly outside the classroom (see Photograph 7.1); seven computers in a peer-to-peer network in the upper school shared area, which was just around the corner from the classroom (See Photograph 7.2); and two computers outside the Y7 class.

Photograph 7.1 Four computers outside 4SL (which can be seen in the background to the right of the picture)

Photograph 7.2 Seven computers in a peer-to-peer network in the upper school shared area

4SL also had use of approximately 27 Psion PocketBooks, including 20 which were shared across the whole school and stored in the head teacher's office, one specifically for use by a child in the class as part of his SEN provision, and the six PocketBooks and peripherals provided by the researcher.

Comparisons of the descriptions of the practice surrounding computer use based on the Computer Practice Framework

Five different sets of descriptions of the practice in 4SL based on the CPF were produced, as summarised in Table 7.6.

Table 7.6 Summary of different descriptions produced

		Researcher	Teacher
	Holistic judgement	Yes	Yes
Weighted description of	**6 activities seen by researcher**	Yes	Yes
	all 14 activities in summer term	No	Yes

The weighted descriptions were produced by analysing each activity individually and then weighting those descriptions in proportion to the length of the activity and the number of children involved. The Quantity of computer use each day was averaged over the number of days during which the activities took place (see Appendix L for copies of the spreadsheets showing the Researcher's and Teacher's analyses, including weightings). The researcher carried out his analysis of each of the activities that he had observed without discussion with the teacher. He subsequently interviewed Mrs Light on two separate occasions, during which he asked her to rate each activity individually. Mrs Light was not aware of the Researcher's ratings at these times. Table 7.7 presents the five different descriptions of the computer use in 4SL based on the CPF.

Table 7.7 Five descriptions of computer use in 4SL based on the CPF

	Researcher		Teacher		
	Holistic	Weighted for 6 activities seen by researcher	Holistic	Weighted for 6 activities seen by researcher	Weighted for all 14 activities in Summer term
Quantity					
%	4	14	4	14	8
Focus					
IT	70	48	50	56	52
Learning Tool	20	42	40	38	43
Other	10	9	10	6	5
Mode					
Repetition	40	25	50	23	26
Replacement	0	0	0	5	3
Extension	50	75	25	72	51
Transformation	10	0	25	0	20

Figure 7.4 shows the Quantity of computer use for each of the five descriptions. It shows that the researcher's and teacher's holistic descriptions of the quantity of computer use were the same, and that the researcher's and teacher's analysis of the quantity of computer use based on looking at each of the 6 activities that the researcher observed were the same. However, it also shows that both the researcher's and teacher's holistic judgements seemed to underestimate the quantity of computer use, and that Mrs Light's analysis of the quantity of computer use over the term as a whole was higher than either of the holistic judgements but lower than for the activities that the researcher observed.

It seemed reasonable to conclude that there was an unusually high level of computer use during the periods when the researcher was present and that one or more computers were in use by children in 4SL for 8% of the school day on average over the summer term. The discrepancy between this figure and the 4% estimated by both the researcher's and Mrs

Light's holistic judgements was significant in the sense of being different by a factor of two. However, the holistic judgement still provided a reasonable indicator of the overall low level of computer use in 4SL, amounting to less than 30 minutes a day on average. This analysis suggested a high level of agreement between the researcher and Mrs Light in their descriptions based on the Quantity dimension of the CPF.

Figure 7.4 The Quantity of computer use according to the five analyses

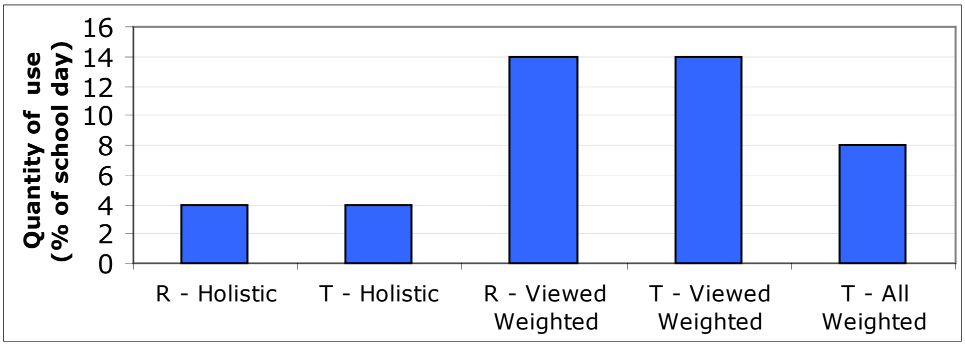


Figure 7.5 shows the Focus of computer use for each of the five descriptions. It indicates that the researcher's holistic judgement overestimated the relative focus on IT, and that the teacher's holistic judgement provided a close match to the descriptions of the Focus of the computer use based on the three weighted analyses. With the exception of the researcher's holistic judgement all of the classifications of the categories on the Focus dimension fell within 8% of each other. This analysis seemed to suggest that the researcher's holistic judgement was unreliable, but provided evidence to support the view that the teacher's holistic judgement was a reliable indicator of the Focus of computer use, though the question of the validity of that description still remained unresolved.

Figure 7.5 The Focus of computer use according to the five different analyses

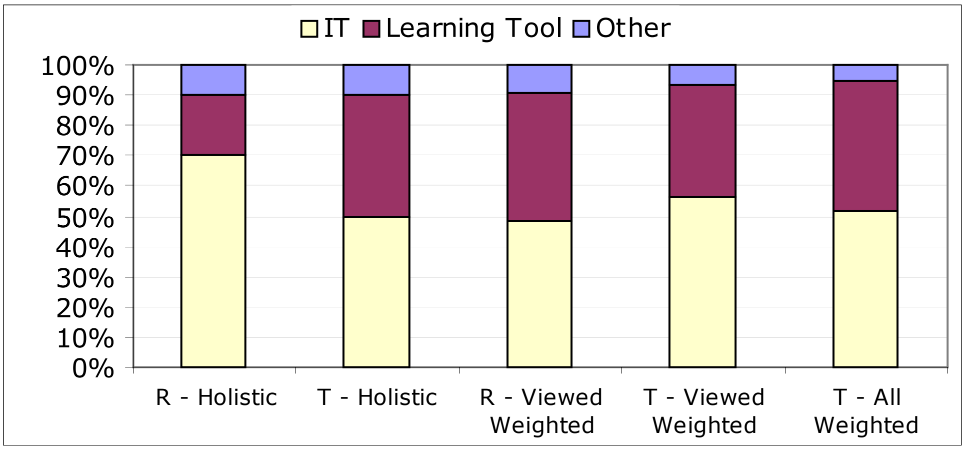
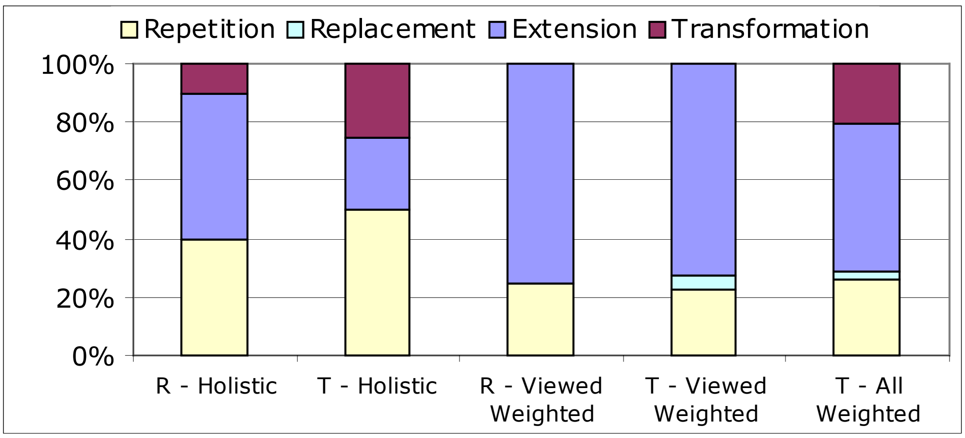


Figure 7.6 shows the Mode of computer use for each of the five descriptions. It indicates that there was a close match between the researcher's and teacher's analyses of the Mode of computer use for the 6 activities observed by the researcher. However, it also showed that there was not a close match between the researcher's and teacher's holistic judgements of the Mode of computer use, or between the holistic judgements and the descriptions based on the weighted analysis of the 6 activities observed by the researcher. This analysis revealed much greater inconsistency between the five descriptions of the computer use in relation to the Mode dimension than for the Quantity or Focus dimensions. In particular it suggested that holistic judgements of the Mode of computer use, as defined in this version of the CPF, were not reliable.

Figure 7.6 The Mode of computer use according to the five different analyses



Conclusions from Case Study 6

Overall the evidence indicated that the teacher's holistic judgements were consistent with the more detailed weighted analyses of computer use for the Quantity and Focus dimensions. However, this was not the case for the Mode dimension, and the researcher's holistic judgements of the Focus of computer use were at odds with the teacher's.

In the light of this, the analysis of the data from Case Study 6 to inform the question of the validity of the CPF was suspended whilst further work was undertaken to enhance the Mode dimension and further test the inter-operator reliability of the CPF. In Chapter 2 it was argued that reliability was a pre-requisite for validity. Thus, unless the CPF could be applied consistently the validity of the descriptions it produced would be called into doubt, reducing the value of further analysis of the data from Case Study 6.

Modifications to the CPF

In the light of the experience of using the CPF with Mrs Light in Case Study 6, several minor changes were made to the Quantity and Focus dimensions in order to enhance inter-operator reliability.

The way in which the Quantity dimension was described was altered, to make it less abstract and tie in the definition more closely with the instructions for how to calculate the Quantity of computer use (see Table 7.8)

Table 7.8 Refined definition of the Quantity dimension

In order to work out the Quantity of computer use you need to calculate the number of minutes during which one or more computers are used by one or more children during the school day. In doing this calculation: • The school day is taken to mean time when children are in school but excludes play times, lunch times, after school clubs, etc; • If a computer is being used with children (even if they are not controlling the keys/mouse) that counts as it being used by the children.

The definitions of the Focus dimension and its sub-categories were also refined (see Table 7.9), and further exemplification was provided. The most significant change was to replace 'the reasons why you are using a computer' with 'the objectives that the computer use sustains' in the overall definition of the Focus dimension. This was an attempt to direct attention to the implementation of the computer use rather than to what the teacher might have intended the Focus to be. The need to do this had become apparent in Case Study 6, where what the teacher had hoped the Focus would be and what it actually was in practice were not the same.

Table 7.9 Refined definition of the Focus dimension

The Focus deals with the objectives that the computer use sustains, when it is implemented. The possible objectives for using a computer are sub-divided into three categories on the Focus dimension: ***IT*** - **Using computers in a way that helps children to develop their ICT skills, knowledge and understanding.** The emphasis here is on using a computer to extend the children's knowledge, understanding or skill in computer use itself. ***Learning Tool*** - **Using computers in a way that supports any aspect of children's learning other than ICT itself.** This would include the following three areas: *Curriculum Tool* - Using computers as tools in a way that helps children to develop skills, knowledge and understanding in another curriculum area (i.e. other than ICT). The emphasis here is on using the computer as a tool to enhance their learning in another curriculum area rather than in the area of IT itself. *Mathetic Tool* - Using computers as tools to develop children's ability to learn and enhance their approaches to learning. *Affective Tool* - Using computers as tools to support and enhance the affective aspects of children's learning. ***Other*** - **Using the computer for some other reason (i.e. not covered by *IT* or *Learning Tool*).** Reasons for using computers that fall within this category may be focussed on practical aspects of the learning situation or the larger context in which the computer use is taking place. **At any one time all three foci always apply to some degree.** The key to the Focus dimension is the relative extent to which each of these three aspects applies. It is important when thinking about the Focus to distinguish between what a teacher would like the objectives to be, what she plans the objectives to be, and what they are when the activity is implemented. **The Focus (and indeed the whole of the CPF) is concerned with what actually happens when a computer is used, not what was intended.** The Focus of use will alter over time, even within the same activity. Thus, when deciding on the relative weighting of each of the aspects on the Focus dimension you have to **take an average weighting over the time period that you are interested in**.

The Mode dimension was altered more radically, both in the light of the previous feedback and as a result of reflection on the ways in which computers could be used. The Mode was attempting to get at differences in the way in which computers were used, which resonated with discussions that were apparent in the literature relating to the extent to which using computers impacted on practice. Maddux (1994) for example, distinguished between what he called Type I and Type II computer applications: Type I "make it easier, quicker, or otherwise more efficient to continue to teach in traditional ways." (p.131); Type II "make new and better methods of teaching and learning available to us - ways that would not be available without technology." (p.131).

Mullens (1995) in his review of approaches to collecting data on classroom instructional processes emphasised the importance of "the content presented and the pedagogy employed" which he argued, following (Porter 1993), "are the two best predictors of student achievement" (p.3). Linking the notion of the impact of ICT with the curriculum, in terms of both content and process, seemed to fit with the underlying aims of the Mode dimension. The definition of the Mode dimension was thus revised so that rather than being about 'how computers are used' it dealt with 'the impact that computer use had on the curriculum' where curriculum was taken to include both the content and processes of learning.

The Replication and Replacement categories were merged, as the distinction between them had not been one that Mrs Light had found intuitive and the difference in terms of impact on the curriculum appeared to be minimal. The resultant category, Support, corresponding to Maddux's Type I applications. The Extend and Transform categories remained, but were redefined to deal with changes in the curriculum, with a clear distinction between those changes which could have taken place without a computer and those that could not. These changes to the categories on the Mode dimension are summarised in Table 7.10.

Table 7.10 The definitions of the revised categories on the Mode dimension

	Curriculum			
	Content (Learning objectives ignoring ICT objectives)		**Process** (How they learn)	**Summary**
Support	Same	and	automated but otherwise essentially unchanged	More efficient or effective without changing content
Extend	Different - but does not require a computer	and/or	different - but does not require a computer	Changes content and/or process but could have been achieved in a 'classroom' without a computer
Transform	Different and requires a computer	and/or	different and requires a computer	Changes content and/or process and could not have been achieved in a 'classroom' without a computer

Within this new definition of the Mode, the Transform category corresponds to Maddux's Type II applications. The Extend category forms a bridge between Type I (Support) and Type II (Transform). This is the area within which computer use may act as a catalyst for change in practice.

In order to facilitate the use of the Mode dimension a set of questions was devised which would determine the appropriate category on the Mode dimension for any particular instance of computer use (see Table 7.11).

Table 7.11 Questions used to determine the Mode category for a single activity

		Answer = No	Answer = Yes
1	Has *what* the children are learning changed?	Go to 2	Go to 3
2	Is automation the only change to the *process* through which the children learn in this activity?	Go to 3	Mode is Support
3	Could you do this in a school context without a computer?	Mode is Transform	Mode is Extend

Simple instructions for calculating the Mode over a period of time in which the computer was used more than once were also developed. These comprised taking the average across each instance of computer use as illustrated in Table 7.12.

Table 7.12 Questions used to determine the Mode across multiple activities

Calculate the Mode for each activity on its own. Then take the average across all the activities. For example:		
Activity	**Individual Mode**	**Combined Mode**
1	Transform	Support = 50% Extend = 25% Transform = 25%
2	Extend	
3	Support	
4	Support	

Testing Inter-operator reliability

The specific aim of this investigation was to explore the hypothesis that the CPF could be applied reliably by a number of different observers, with minimal training.

Method

The inter-operator reliability was tested by asking respondents to apply the CPF to secondary materials describing computer use in Case Study 6. This approach was adopted for pragmatic reasons, relating to the practicalities of setting up the investigation. For example, it would have been impossible to have 27 people all observe one class as they used IT, even if all those 27 people were willing and able to do so.

The design had clear limitations therefore. The key dangers related to the quality of the secondary data that was provided to describe the computer use, and to which the respondents were going to apply the CPF. Firstly, the data was clearly less rich than would have been the case if the respondents had been able to observe the computer use and interview the teacher and children in person. Secondly, and inevitably, the data represented a particular view of the computer use in terms of what aspects the researcher noticed and/or thought sufficiently important to record. These limitations in the design of the inter-operator reliability test were felt to be unavoidable.

Volunteers to take part in this investigation were sought from two sources. Firstly, an email was sent to the Association for IT in Teacher Education (ITTE) mail-list asking for volunteers to apply the CPF to some scenarios in which computers were being used. Secondly, a session was scheduled to take place at the ITTE Research Conference (Nov 2000) in order to recruit volunteers.

The ITTE mail-list, at the time when this research took place, included some 90 people. All of these people were members of ITTE. This meant that they were either members of an educational institution or a company that had an institutional subscription to ITTE or were individual members. 21 members of the list responded saying that they would be willing to take part, and a small number of others expressed interest but said that they were not available during the period when the work needed to be done.

Approximately 50 people attended the ITTE Research Conference. The vast majority of these people were also members of the ITTE mail-list. All of them were members of ITTE, either as part of their institution or as personal members. An additional 14 people volunteered to take part in the study at the ITTE Research Conference.

Each volunteer was provided with the following materials:

- A set of instructions, which explained what they had to do and how to apply the CPF (Appendix M).
- Three scenarios, presented in the form of data from Case Study 6. These included: schemes of work, a weekly timetable, weekly plans, logs of computer use, transcripts of non-participant observations, photographs, and transcripts of interviews (Appendix N).
- A response sheet (Appendix O).
- A pre-paid SAE for returning the response sheet.

The three scenarios included:

1. 3 children from 4SL working together on one computer using the Anglo Saxons CD;
2. 1 child using Creative Writer, having finished her other work;
3. half the class using Dazzle.

The respondents were also asked to describe the overall computer use across the whole term, which was labelled Scenario 4.

Those volunteers who attended the scheduled session at the ITTE research conference were provided with the same set of materials as they would have received had they responded to the original email request. No further explanation or description of the task was given to that provided in the original emails. The scheduled session was simply used to distribute the materials and then the session ended. The researcher took great care *not* to discuss the CPF with the volunteers.

Data Analysis

The initial data analysis concentrated on the extent to which different respondents produced the same descriptions using the CPF for each of the three scenarios separately and for the overall description of computer use spanning all three scenarios. In essence this involved completing Table 7.13, though in analysing the data it was important to remember that the CPF was designed to be viewed holistically.

Table 7.13 Grid to be completed to show degree of similarity between responses

Degree of similarity	Quantity	Focus	Mode
Scenario 1			
Scenario 2			
Scenario 3			
Scenario 4			

Subsequently the data were analysed to examine what they had to say about how the raters produced their descriptions in order to see if that revealed ways in which the CPF could be further refined. In total 27 respondents returned their descriptions based on the CPF. However, not all of the respondents addressed each scenario for each dimension of the CPF.

Quantity

For each scenario the respondents were asked to identify the amount of computer use in minutes. Scenarios 1 to 3 asked the raters to estimate the number of minutes for which computers were in use by one or more children doing one specific activity. Scenario 4 was qualitatively different in that it asked the raters to estimate the average number of minutes per week that computers were in use over the whole term. The raters had less data relating to Scenario 4 than they had for the other three scenarios.

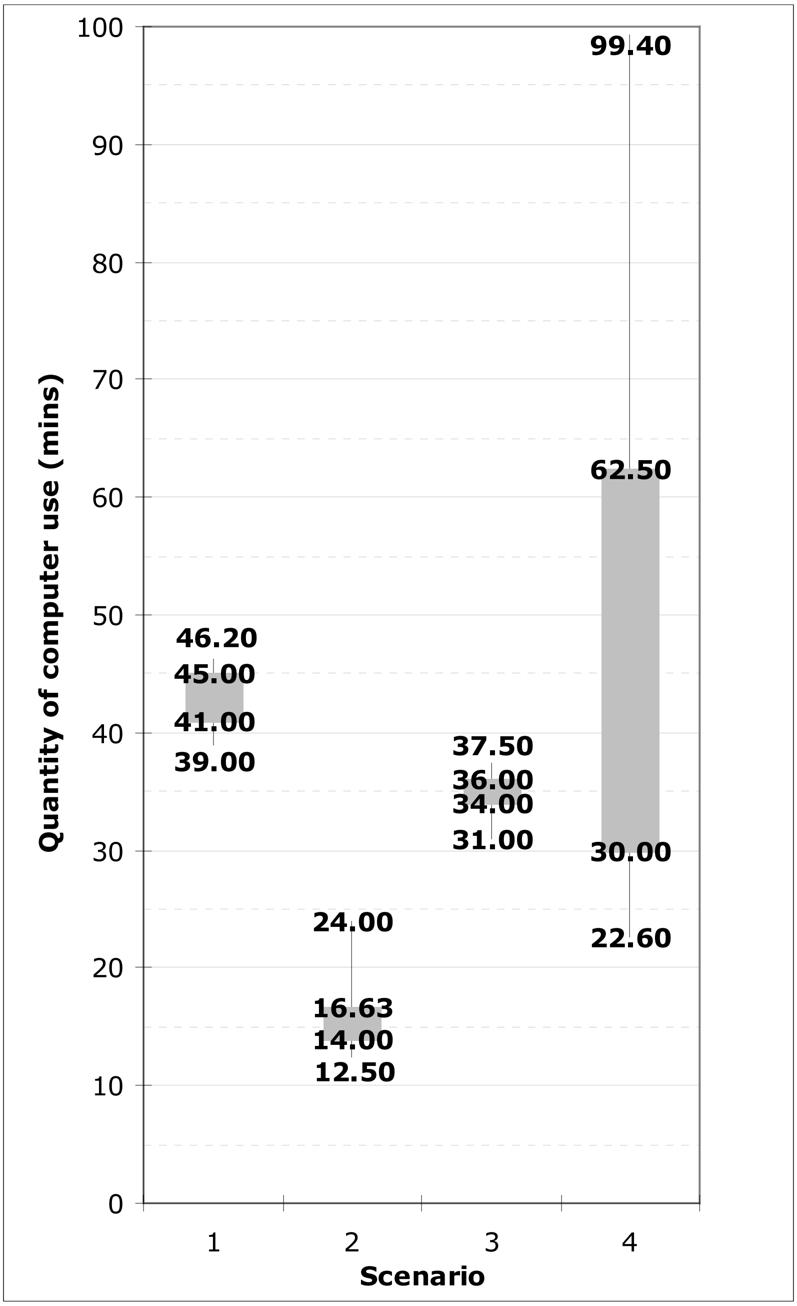
Figure 7.7 shows the range of times (mins) that each of the raters estimated that computers were in use on each scenario.

Figure 7.7 Distribution of values allocated by raters for the amount of time that computers were in use for each Scenario

Scenario	n =
1	27
2	26
3	26
4	19

The values shown represent the 10th, 25th, 75th and 90th percentiles.

The grey areas represent the ranges within which 50% of the responses fell.



Figures 7.8 to 7.11 show frequency graphs, which plot the number of raters against the quantity of computer use for each scenario. Figures 7.8 to 7.10 suggested that the raters were generally consistent in their estimates for Scenarios 1 to 3. In each of these cases there were a number of rogue entries, but the majority of responses were clustered for each of these three scenarios.

Figure 7.8 Number of respondents against quantity of computer use for Scenario 1

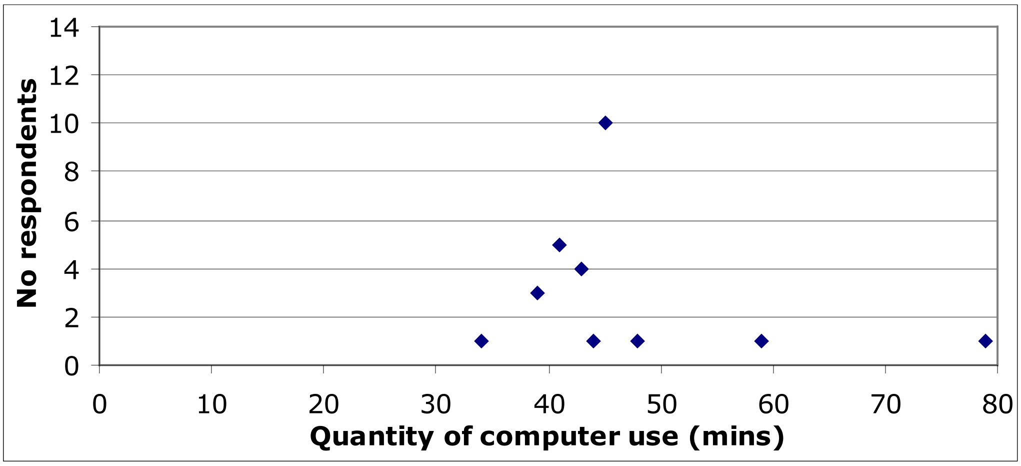


Figure 7.9 Number of respondents against quantity of computer use for Scenario 2

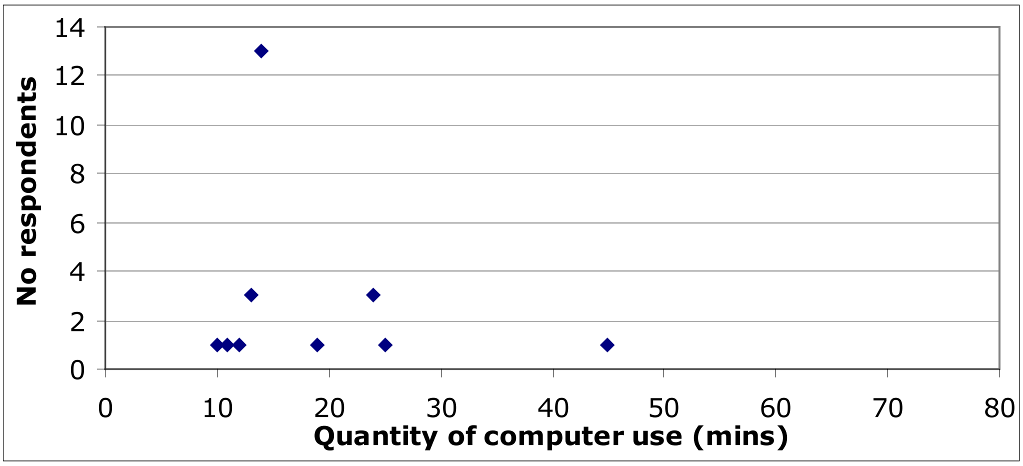


Figure 7.10 Number of respondents against quantity of computer use for Scenario 3

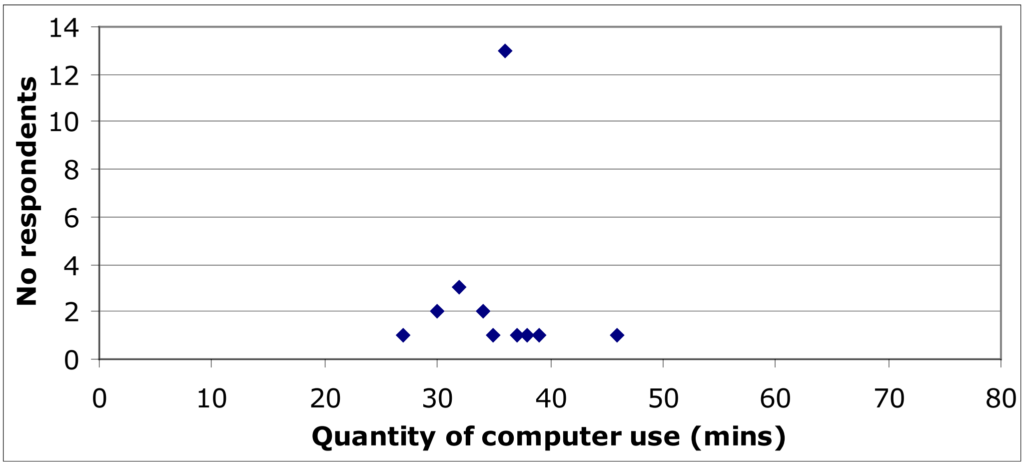
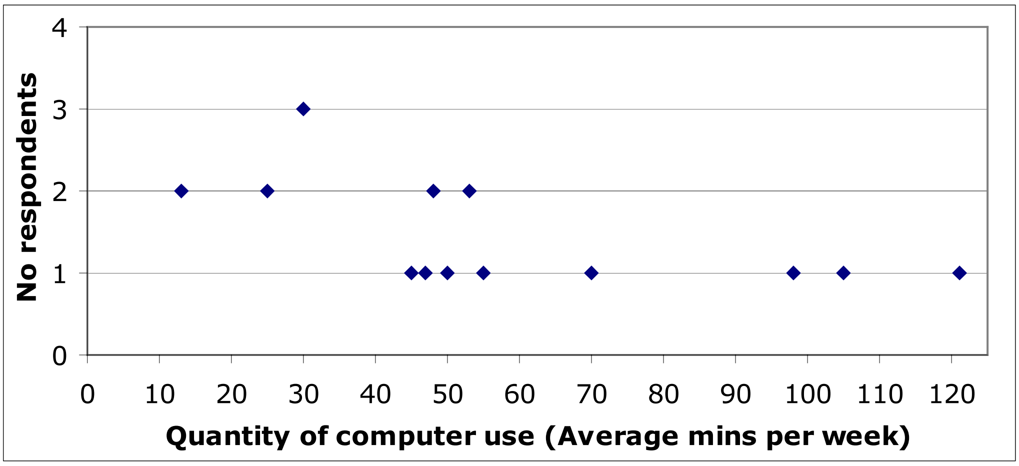


Figure 7.11 Number of respondents against quantity of computer use for Scenario 4

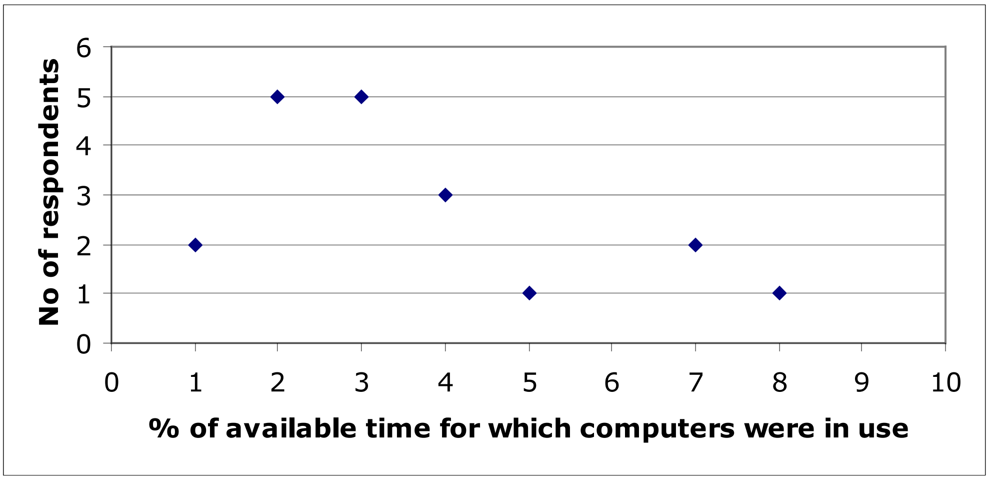


Figures 7.7 and 7.11 suggested that the raters were not consistent in their estimates for Scenario 4. This discrepancy seemed to relate to the way in which the raters estimated the quantity of computer use. Some raters simply took the average from Scenarios 1 to 3 and ignored the other data. Others used all of the data provided, including the Schemes of work, weekly plans and computer logs.

Converting the ratings for Scenario 4 into percentages of the available time during which computers could have been in use produced a very different picture of the inter-rater reliability. The data then suggested that all the raters were quite consistent, as shown in

Figure 7.12, which indicated that all the raters estimated that computers were in use on average over the term for less than 8% of the time. This level of consistency was more than adequate for the Quantity dimension, which is only intended to give a feel for the amount of computer use.

Figure 7.12 Number of respondents against the quantity of computer use, as a percentage of the maximum available, for Scenario 4



Focus

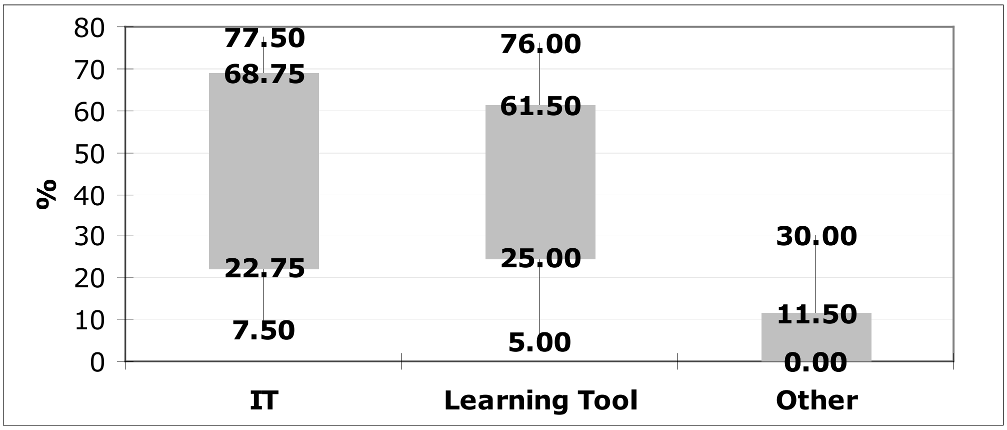
For each scenario two different analyses were carried out to establish the degree of similarity between the different respondents' descriptions on this dimension. Firstly the 10th, 25th, 75th and 90th percentiles for the percentages allocated by the raters on each of the three Focus categories were plotted (Figures 7.13, 7.17, 7.21 and 7.25). The shaded areas in each of these Figures represent the ranges within which 50% of the responses fell. Secondly, frequency graphs were plotted showing the number of respondents against the percentages allocated to each of the categories on the Focus dimension (Figures 7.14 to 7.16, 7.18 to 7.20, 7.22 to 7.24, and 7.26 to 7.28).

Scenario 1

The initial impression created by Figure 7.13 was that there was a pattern in the way that Scenario 1 was described on the Focus dimension by these 26 respondents: the percentage of IT and Learning Technology were roughly equal and were greater than the percentage of

Other (IT ≅ LT > Other). However, closer examination revealed that there was a wide spread in the percentages allocated for each of the categories.

Figure 7.13 Distribution of percentages for each of the Focus categories in Scenario 1 (n=26, 10th to 90th percentiles)



Plotting frequency graphs of the number of respondents against the percentage to which each of the categories on the Focus dimension applied seemed to confirm this view (see Figures 7.14 to 7.16). These graphs show that the responses were widely spread, with little evidence of clustering, particularly in relation to the IT and Learning Tool categories. Thus, the inter-respondent reliability was low for this scenario on this dimension.

Figure 7.14 Number of respondents against the percentage to which IT applied in Scenario 1

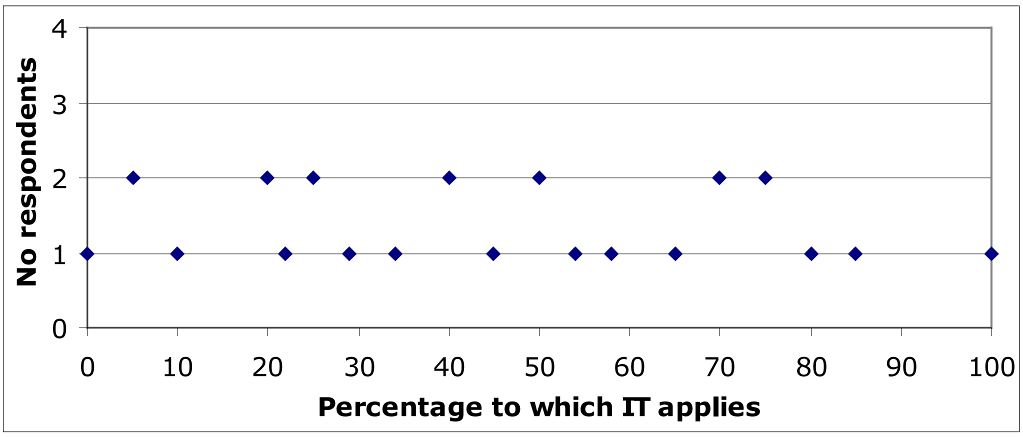


Figure 7.15 Number of respondents against the percentage to which Learning Tool applied in Scenario 1

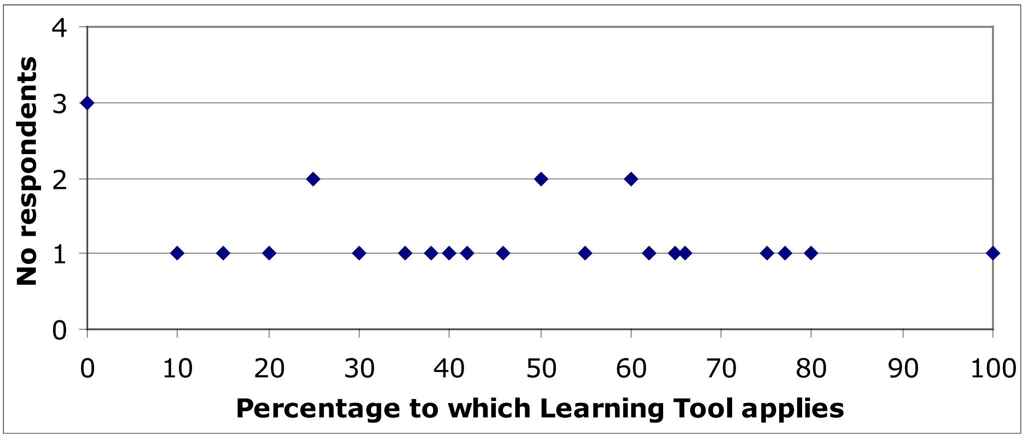
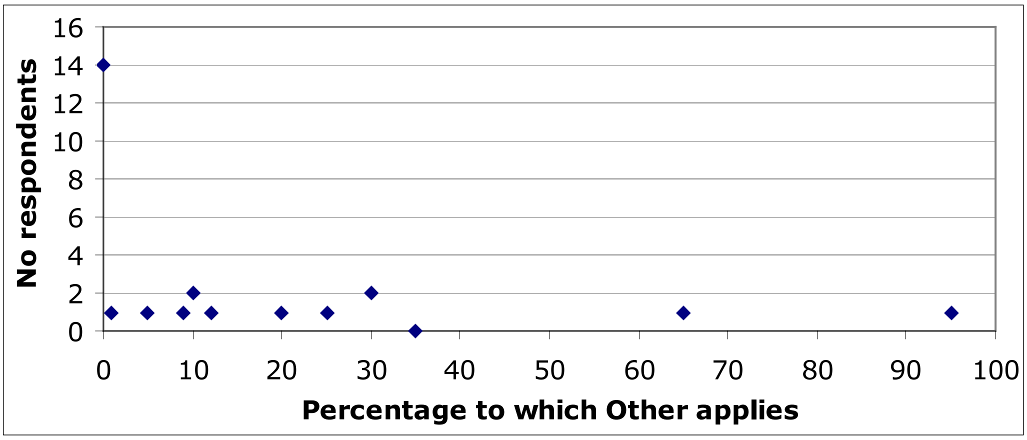


Figure 7.16 Number of respondents against the percentage to which Other applied in Scenario 1



Looking at the respondents comments it was clear that a number of issues were impacting on the ratings they allocated on this dimension.

Two different approaches were taken to rating the Focus. Some respondents made a holistic judgement for the activity, based on having examined all the data, whilst others calculated the Focus for each minute during which the activity was taking place and then combined these ratings to come to an overall rating for the activity as a whole:

> My weightings [IT 54%, LT 46%, Other 0%] were calculated quantitatively but if I was considering it qualitatively they would be IT 35%, LT 5%, Other 60%.
> (Respondent 2)

A number of respondents said that they were unclear about the extent to which the children were learning anything (other than how to use the technology) as they used the Anglo Saxon CD. This impacted on their judgements in different ways. Some decided that because learning was not taking place the Focus couldn't be on Learning Tool:

> Purpose of activity not articulated with sufficient clarity for 'learning' to take place. (70% IT)
>
> (Respondent 4)

Others thought that the Focus was on Learning Tool even if learning wasn't being achieved:

> I took the view that the children were oriented towards using the computer as a learning tool even though learning wasn't taking place. (62% Learning Tool)
>
> (Respondent 5)

> However inept and inefficient, children were focussed on trying to obtain information. (66% Learning Tool)
>
> (Respondent 9)

There were also differences in the ways in which the IT category was interpreted. Some respondents thought that searching for data on a CD fell into the IT category:

> Most of the time is spent on the operation of the software – searching, using hot links, copying and pasting. (IT 75%)
>
> (Respondent 13)

> All the rest of the time the children are learning how to move around the CD, trying to search for material which never succeeds or trying to print. (IT 75%)
>
> (Respondent 17)

Others thought it was a generic skill which came under Learning Tool:

> Copy, paste, search skills are ICT and generic. (IT 25%, Learning Tool 50%)
>
> (Respondent 8)

> Operational issues relatively less significant for pupils although searching problems impede them slightly. Overall, children more involved in locating relevant material than operating computer. (Learning Tool 60%)
>
> (Respondent 18)

Another problem that respondents raised was lack of clarity about how to handle differences between the Focus for different children involved in the activity. Some raters appeared to make a holistic judgement (and did not raise differences between the children as being an issue). Some made a weighted judgement based on the Focus for each child:

> If two children were doing different things in the same 5 minutes, I split the time in two.
>
> (Respondent 22)

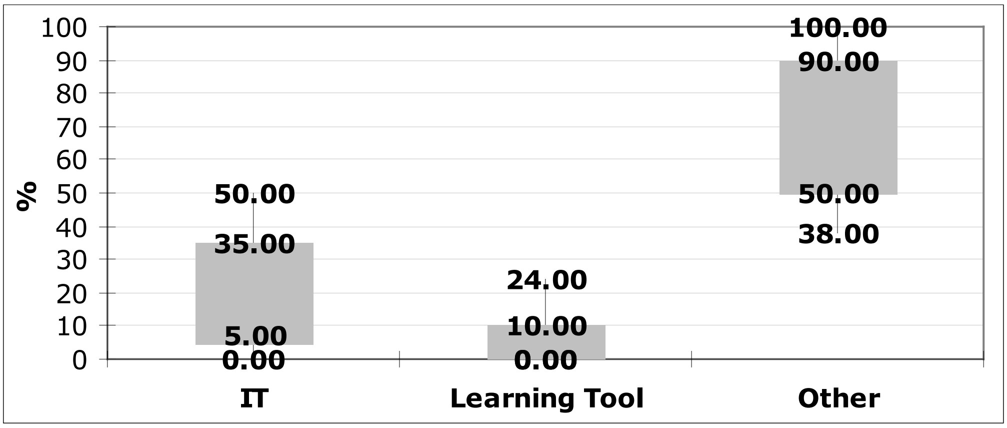
At least one based her judgement on one child from the group:

> I focussed on the activity of "at least one of the group" rather than the whole group – as at each point they were not all 'engaged'.
>
> (Respondent 21)

Scenario 2

Figure 7.17 seemed to indicate that there was a pattern in the way that the respondents described Scenario 2 using the Focus dimension. Other was the predominant Focus, followed by IT and then Learning Tool (Other > IT > LT). There was little overlap between these categories. However, as had been the case for Scenario 1, the spread of percentages for each category was still large.

Figure 7.17 Distribution of percentages for each of the Focus categories in Scenario 2 (n=27, 10th to 90th percentiles)



Plotting the number of respondents against the percentage to which each of the categories on the Focus dimension applied reinforced this view (see Figures 7.18 to 7.20), particularly in relation to the Other category.

Figure 7.18 Number of respondents against the percentage to which IT applied in Scenario 2

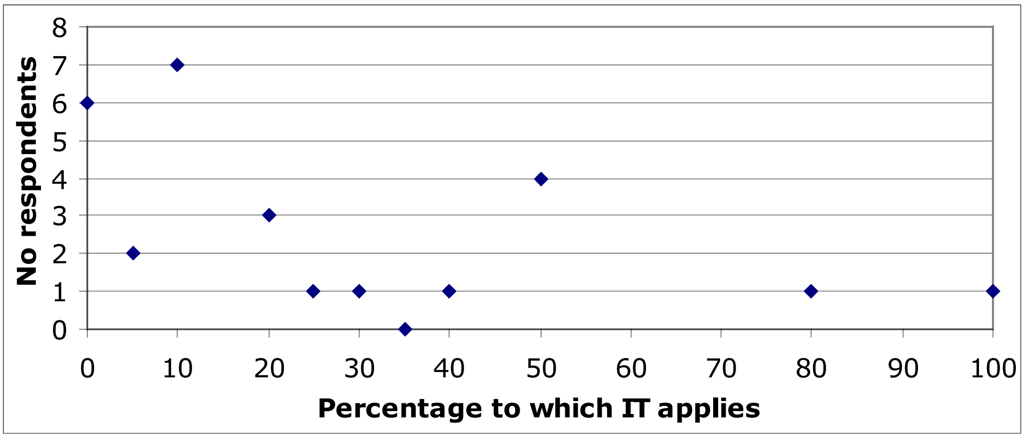


Figure 7.19 Number of respondents against the percentage to which Learning Tool applied in Scenario 2

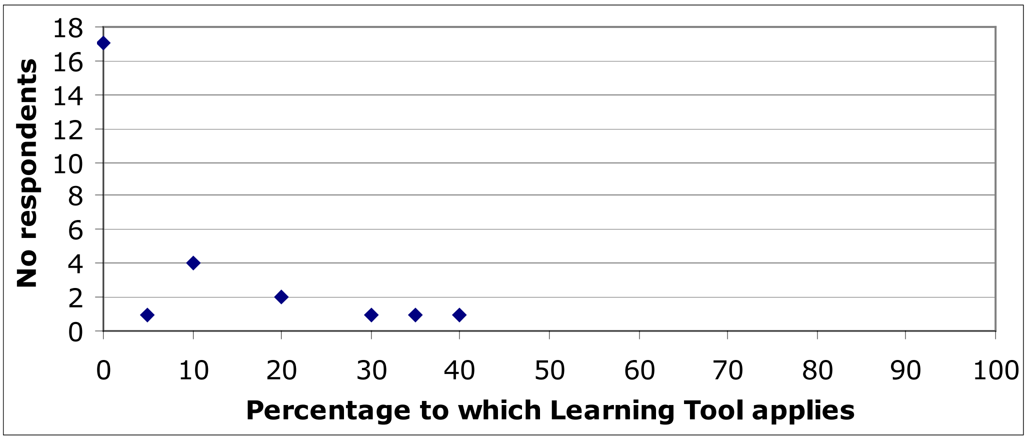
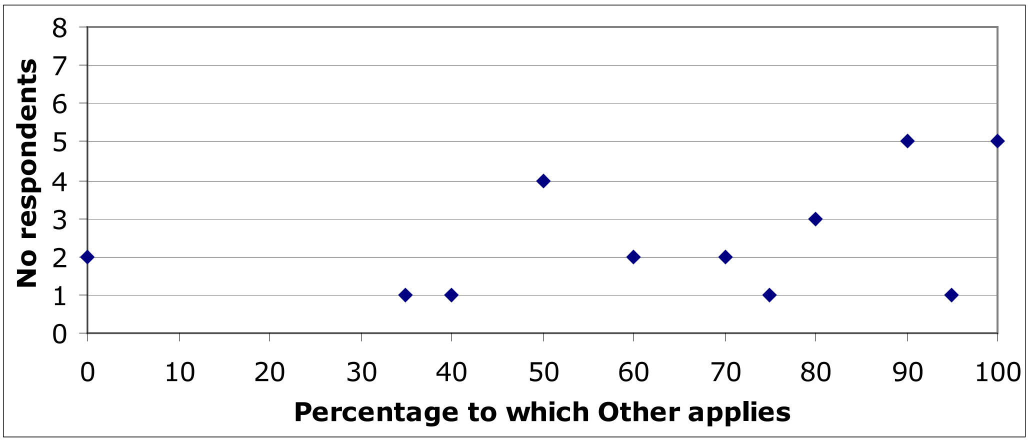


Figure 7.20 Number of respondents against the percentage to which Other applied in Scenario 2



A number of issues were raised by the respondents, which had an impact on the way that they rated the Focus for this scenario. Firstly, there was not sufficient detail to enable definitive decisions to be made about how much Tina learnt:

> Tina might have learnt some new IT skills from the other children – impossible to tell from scenario.
>
> (Respondent 34)

Secondly, whilst all the respondents agreed that the activity was a reward or filler they placed varying degrees of emphasis on that in coming to their judgements.

> Teacher used the activity as a time filler and the pupil worked on that basis! (Other 100%)
>
> (Respondent 3)

> Explicitly time filler because Tina had finished her work. No output expected. Tina learning about the program by playing with it – learning quite a lot about how it works (IT 50%, Other 50%)
>
> (Respondent 40)

In part this appeared to relate to differences in perspective about whether they were rating the teacher's intentions or what the child actually achieved:

> Main reason for use was to keep Tina occupied. Teacher had no clear learning objectives. However, it appears that Tina did improve her own knowledge of how the software works and what it contained. (IT 25% Other 75%)
>
> (Respondent 22)

Another difference that was apparent between the respondents was the extent to which learning that was 'unintended' or 'accidental' counted as learning at all:

> Not sure the subject is in the NC! Not sure that she 'learned' what she was trying to find out about. Is an unsuccessful result still 'learning'? Most of it seemed to be 'exploratory'. What she could do with the Hardware/Software but she also had a 'purpose'. (IT 80%, Learning Tool 20%)
>
> (Respondent 27)

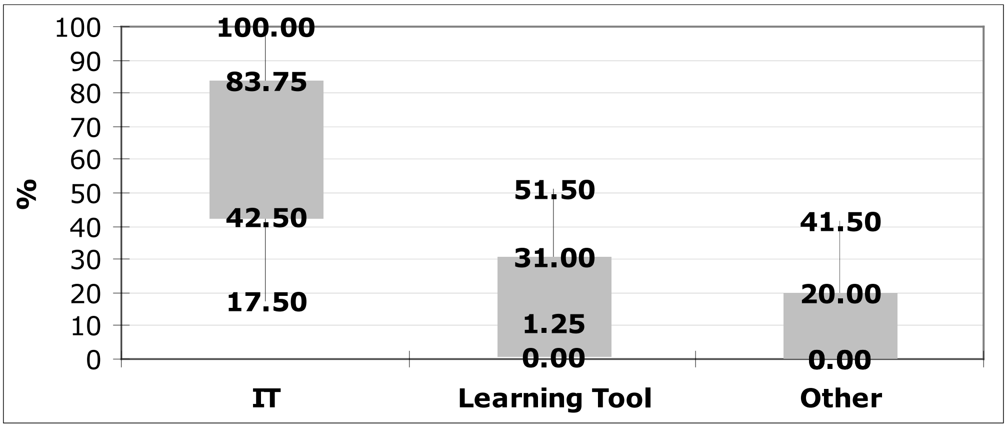
> The unforeseen consequence was the child exploring and although with no formal focus the researcher's comments would suggest that she was exploring a model (?) and 'accidentally' using it as a learning tool. (Learning Tool 30%, Other 70%)
>
> (Respondent 13)

> As no purpose defined for activity – merely used as a reward – minimal contribution to IT development … (IT 5% Other 95%)
>
> (Respondent 35)

Scenario 3

Figure 7.21 indicates that there was a pattern in the way that the respondents described Scenario 3 on the Focus dimension. IT was the predominant Focus, followed by Learning Tool and Other which overlapped (IT > LT ≅ Other). However, as had been the case for Scenarios 1 and 2, the spread of percentages for each category was still large.

Figure 7.21 Distribution of percentages for each of the Focus categories in Scenario 3 (n=26, 10th to 90th percentiles)



Plotting frequency graphs of the number of respondents against the percentage to which each category on the Focus dimension applied showed that the spread of responses was very large (Figures 7.22 to 7.24).

Figure 7.22 Number of respondents against the percentage to which IT applied in Scenario 3

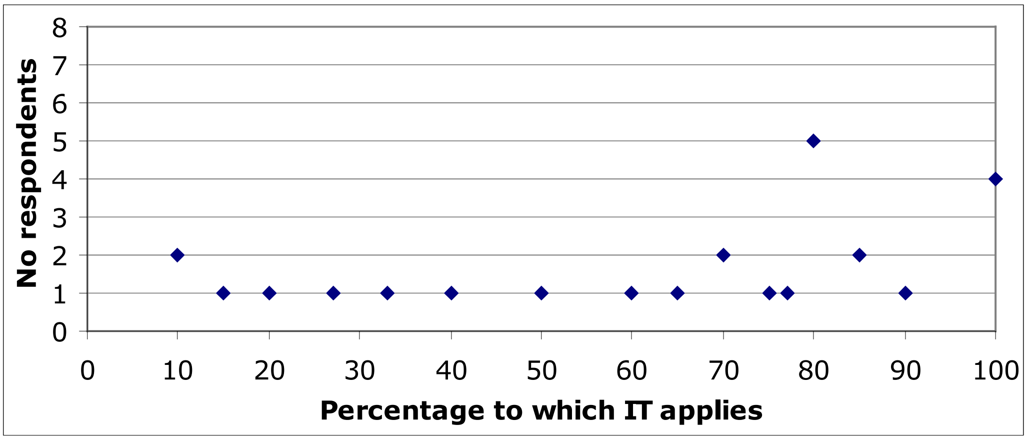


Figure 7.23 Number of respondents against the percentage to which Learning Tool applied in Scenario 3

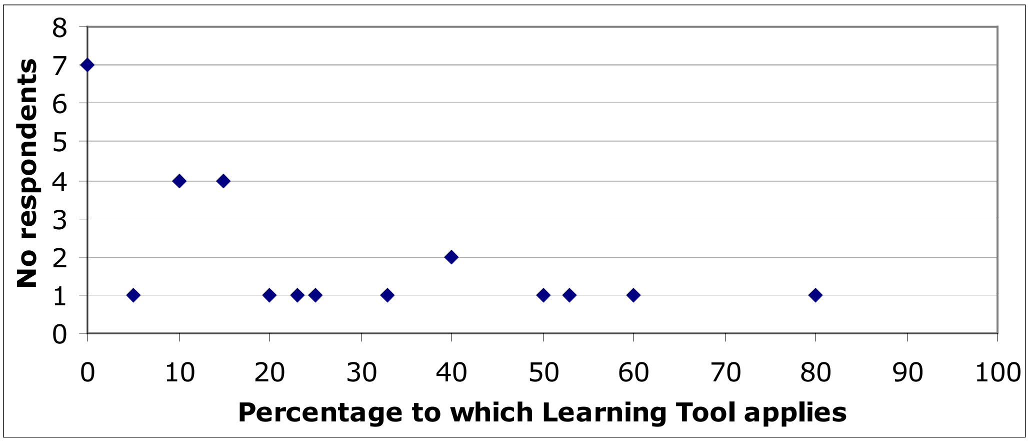
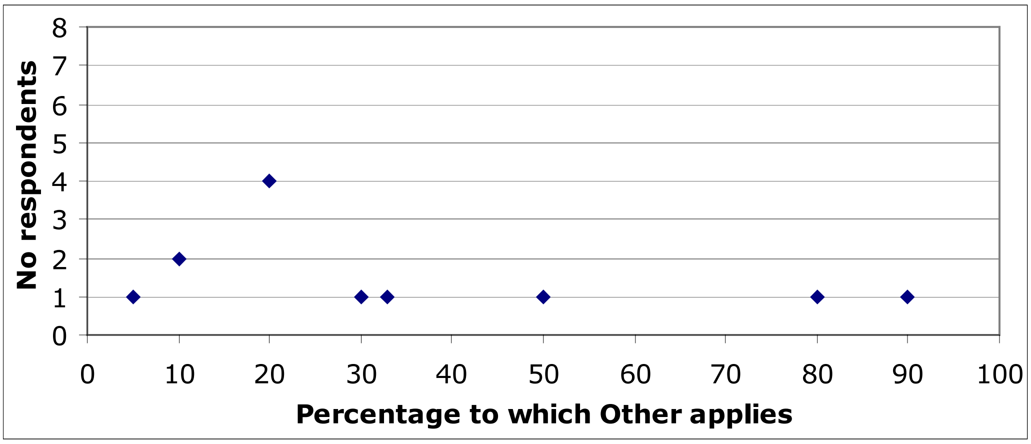


Figure 7.24 Number of respondents against the percentage to which Other applied in Scenario 3



Feedback from the respondents indicated that some of them felt there was a lack of evidence about what individual pairs of children had done within the data they were given, making it very difficult for them to come to firm judgements:

> How do we know what each pair were doing?
>
> (Respondent 7)

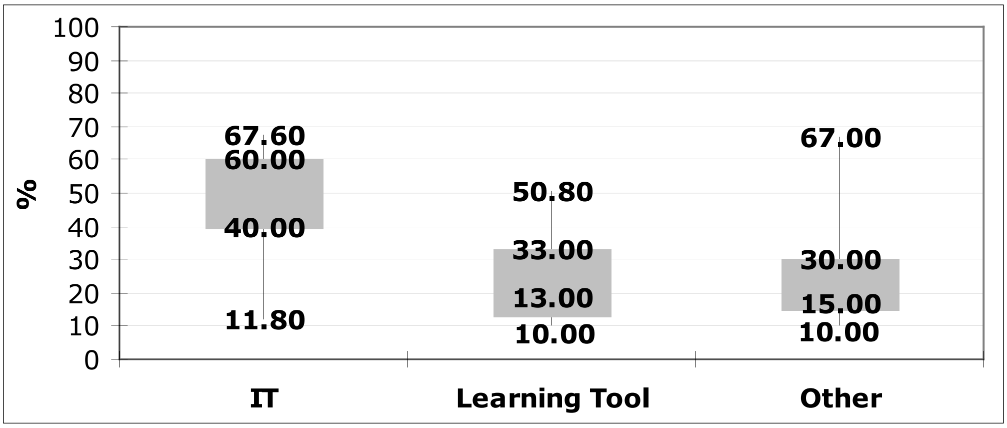
Whilst others felt this activity was much clearer than the previous ones:

> A much more focused activity than the other two. All descriptions and discussions are concerned with IT skills.
>
> (Respondent 2)

Scenario 4

Scenario 4 was different in kind to the previous three scenarios in that it asked for a rating over the whole term rather than over a specific activity. The raters had less data on which to base their judgements in Scenario 4 and had to extrapolate from the three scenarios, the plans and logs that they had been given. Despite this, Figure 7.25 did show a general pattern across the respondents, with IT predominating, followed by Learning Tool and Other which overlapped (IT > LT ≅ Other). However, as had been the case for the previous three scenarios, the spread of percentages for each category was still large.

Figure 7.25 Distribution of percentages for each of the Focus categories in Scenario 4 (n=17, 10th to 90th percentiles)



Plotting frequency graphs of the number of respondents against the percentage to which each category on the Focus dimension applied confirmed this wide spread of responses (Figures 7.26 to 7.28).

Figure 7.26 Number of respondents against the percentage to which IT applied in Scenario 4

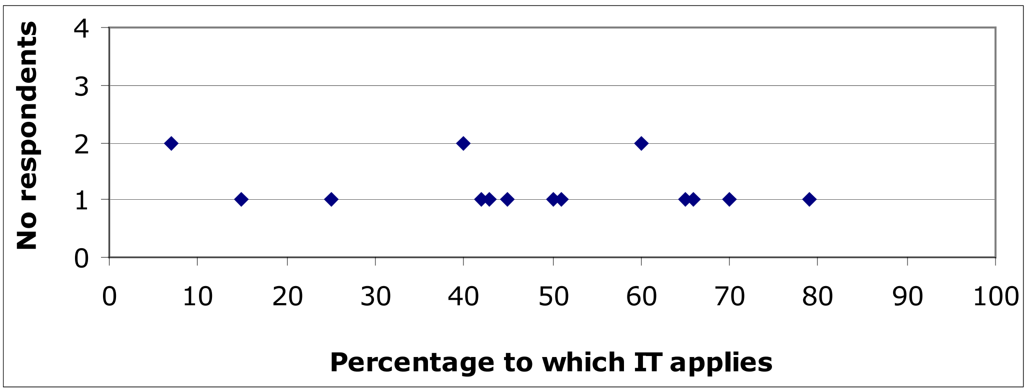


Figure 7.27 Number of respondents against the percentage to which Learning Tool applied in Scenario 4

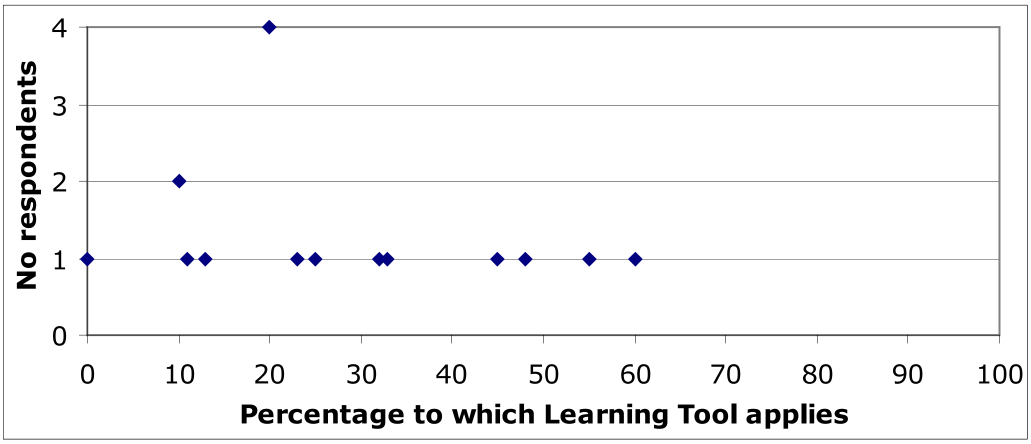
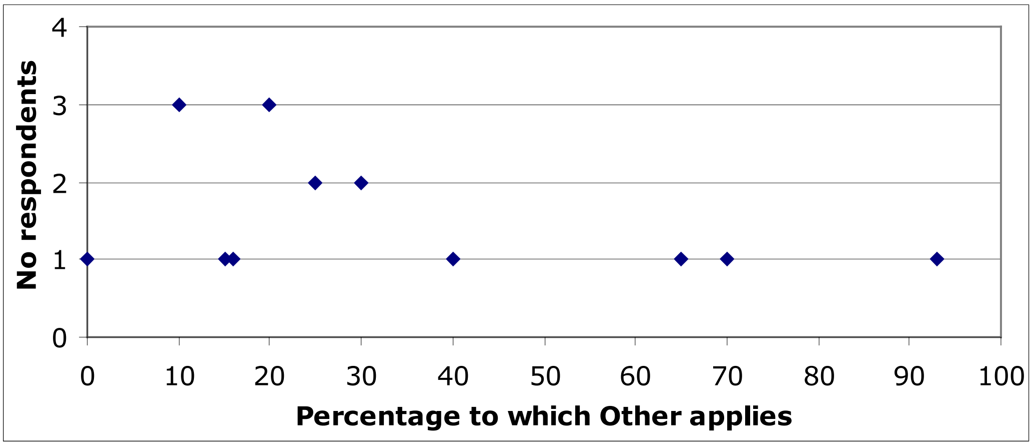


Figure 7.28 Number of respondents against the percentage to which Other applied in Scenario 4



Analysis of the respondents' comments revealed that at least two different approaches had been taken to working out the Focus over the whole term. Some respondents had simply used Scenarios 1 –3 and ignored all the other data:

> Based on evidence from the 3 scenarios. (IT 50%, Learning Tool 25%, Other 25%)
> (Respondent 1)

Whilst others used all of the available data, placing less emphasis on the three scenarios:

> From the overview planning sheet and weekly sheets – the emphasis appears to be on using ICT to develop use across other areas of the curriculum – with some acknowledgement that teaching of discrete ICT skills may be necessary to achieve this aim. (IT 40%, Learning Tool 60%)
> (Respondent 19)

A substantial proportion of the respondents (10 out of 27) did not complete this analysis, often commenting that it would take too long to analyse the data to come to a judgement or that there was not enough data to do more than make a guestimate.

Mode

Scenarios 1 to 3

Respondents were asked to rate the Mode for Scenarios 1 to 3 on the scale shown in Figure 7.29. Thus for each scenario they were asked to give one rating on the Mode dimension. The intention had been that they would select a category (i.e. Support or Extend or Transform). However, all the respondents indicated their judgement by marking the line in some way - usually with a cross.

Figure 7.29 The scale used by raters to show the Mode for each scenario

By measuring from the left hand end of the scale to the mark a measure (in mm) was obtained for each rater of how far along the Mode dimension each scenario fell. These measures were analysed in two ways: using the measure in mm directly; and converting the measure in mm into a category (either Support, Extend or Transform). In order to do this the centre point on the line was calculated and then halved to provide cut off points (as illustrated in Figure 7.30).

Figure 7.30 The scale divided up into sections, showing the different Modes

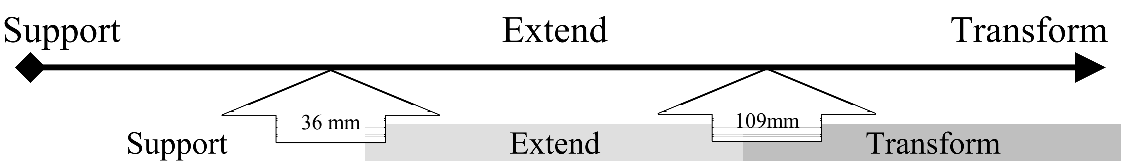


Figure 7.31 is based on the analysis of the categorical data (i.e. measures turned into

categories) for Scenarios 1 to 3.

Figure 7.31 The number of respondents rating each scenario in each category on the Mode dimension (Sc1 n=26, Sc2 n=22, Sc3 n=23)

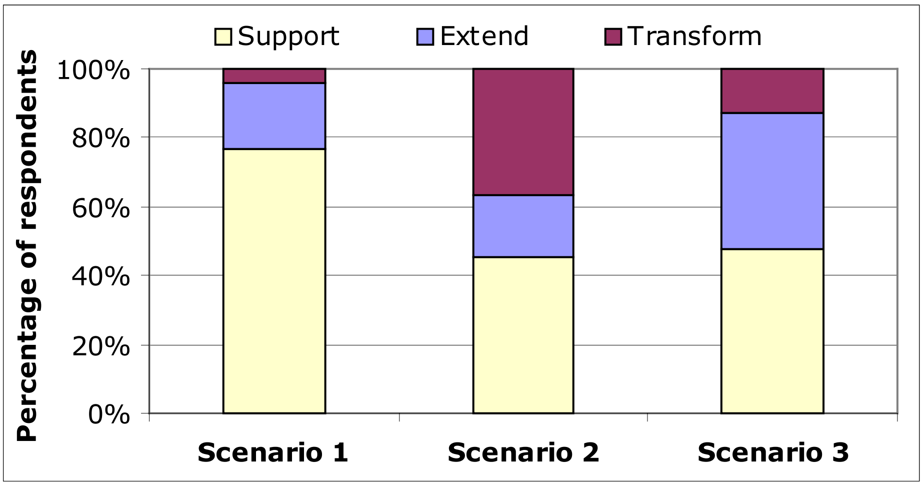


Figure 7.31 indicated that there was little agreement between the respondents about which category on the Mode dimension each of the scenarios belonged in. This view was reinforced by calculating the value for the Kappa statistic (see Appendix P) for the categorical Mode values on the first three scenarios. This gave a K value of 0.132, which suggested that there was little agreement between the raters. Due to the small number of categories (3) it was not appropriate to calculate the significance of K in this case (Siegel and Castellan 1988).

Further support for the view that the Mode dimension had not been applied in the same way by different raters came from plotting frequency graphs of the number of respondents against the measurements for each scenario (Figures 7.32 to 7.34). As some respondents had marked to the left of Support on the Mode dimension (as represented in Figure 7.29) these graphs include some negative distance values.

Figure 7.32 Number of respondents against the distance in mm that they marked along the Mode scale for Scenario 1

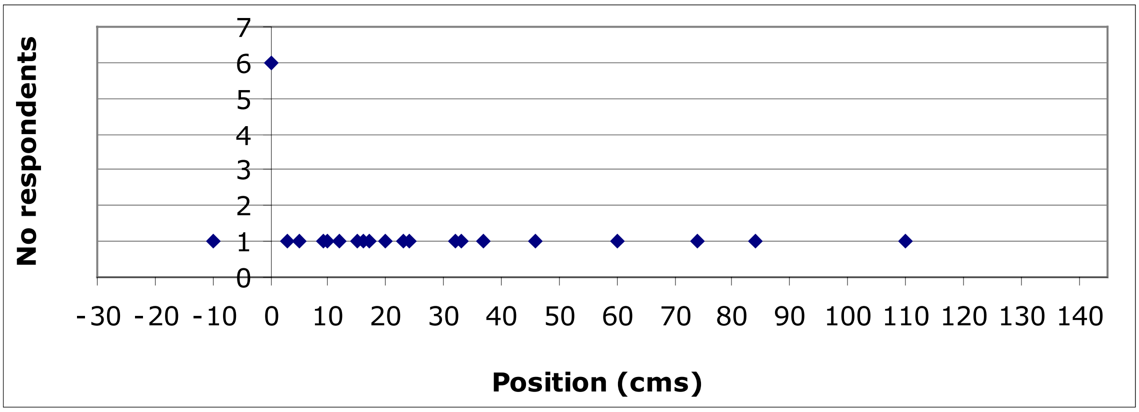


Figure 7.33 Number of respondents against the distance in mm that they marked along the Mode scale for Scenario 2

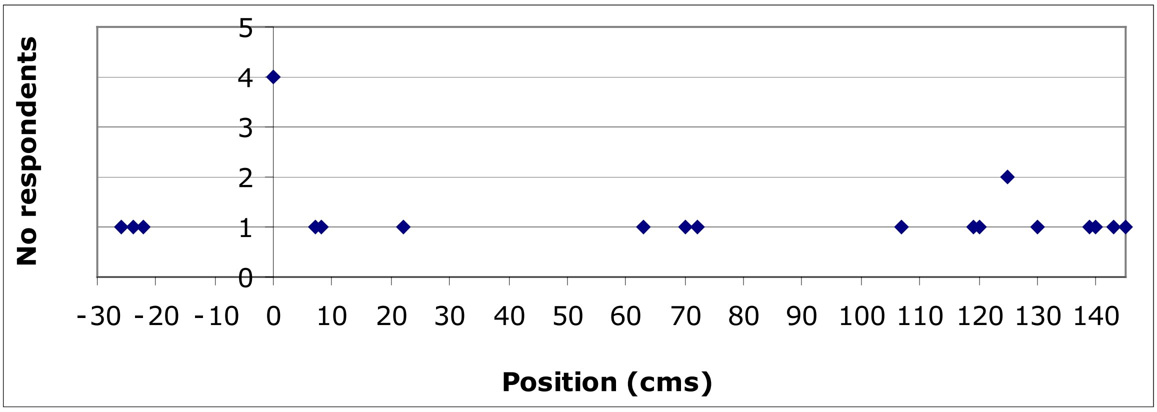
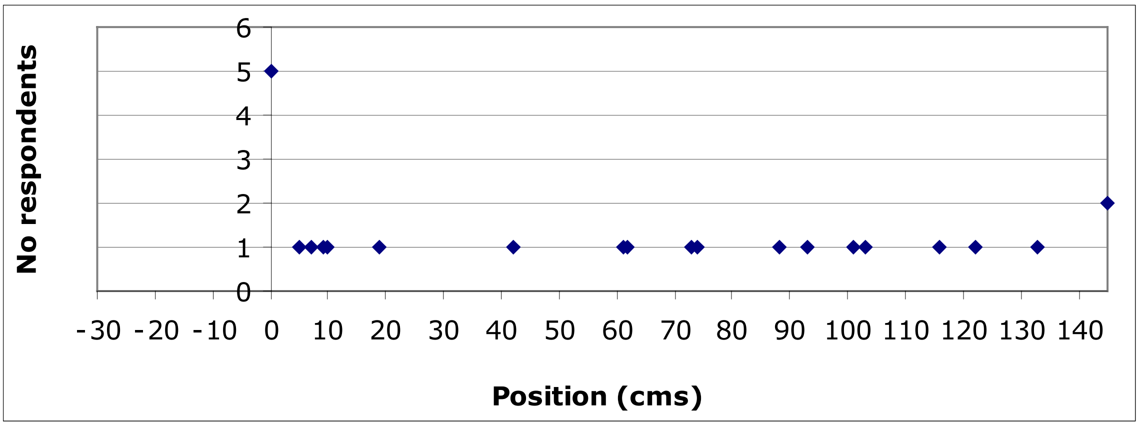


Figure 7.34 Number of respondents against the distance in mm that they marked along the Mode scale for Scenario 3



This analysis showed that there was little consistency between the respondents in how they judged the three scenarios on the Mode dimension. From the respondents' comments a number of possible explanations for this were evident across the three scenarios.

In Scenario 1 many respondents thought that the activity had the potential to extend or even transform the children's learning but in practice it was poorly implemented and thus did not do so. However, some still rated this as Transform:

> It's really hard to answer this as precious little learning seems to take place. Rather like asking me to say in which direction a broken down car is travelling! In the end I can only answer on the margins and say that it marginally could only have been done with a computer (Mode = Transform),
>
> (Respondent 5)

whilst others did not:

> The database side did not work or they got nothing from it. Ideas from the transcript suggest more was hoped for but it didn't, in my view, actually materialize (Mode = Support).
>
> (Respondent 14)

Some respondents went further and said that the computer use in Scenario 1 did not even support the children's learning because very little learning appeared to take place.

> Mode dimension assumes learning I'm not sure any went on here (Placed cross off the scale to the left: –10mm)
>
> (Respondent 34)

Many thought that the activity would have been better if undertaken using a book, because the technology seemed to get in the way of the children's learning.

> More could have been achieved with a simple book. The computer got in the way of effective learning. (Mode = Support)
>
> (Respondent 9)

Similar issues relating to the difference between what was intended and what was achieved were raised in relation to Scenario 2:

> Difficult as there does not appear to be a curriculum or learning objective. However, what Tina actually did (process) could not have been done without the computer. (Mode = Transform)
>
> (Respondent 1)

> Does this mean anything in this context?? The activity was not related to the curriculum. (Mode = Support)
>
> (Respondent 3)

> Find this impossible to score as no apparent LOs [learning outcomes] defined for task – merely a filler. (Gave no Mode rating)
>
> (Respondent 35)

Scenario 3 revealed that some respondents were mistakenly rating activities as Transform if they had ICT objectives and thus required a computer:

> The objectives were totally ICT so does require a computer. (Mode = Transform)
> (Respondent 2)

There was also some disagreement about the extent to which the activity could have been done without a computer, even if you ignored the IT objectives:

> Nothing here that would be exclusive to computer use. Barely constitutes Support. (Mode = Support)
> (Respondent 4)

> Almost impossible to experiment in this way with design on paper. Obviously you can try out on rough paper and its not clear how much pupils really take advantage of possibilities so that's why I have some doubts. (Mode marked as Extend and Transform – two crosses)
> (Respondent 39)

It was also clear from Scenario 3 that many of the respondents were treating the Mode dimension as a continuum rather than treating each of the three categories as being discrete:

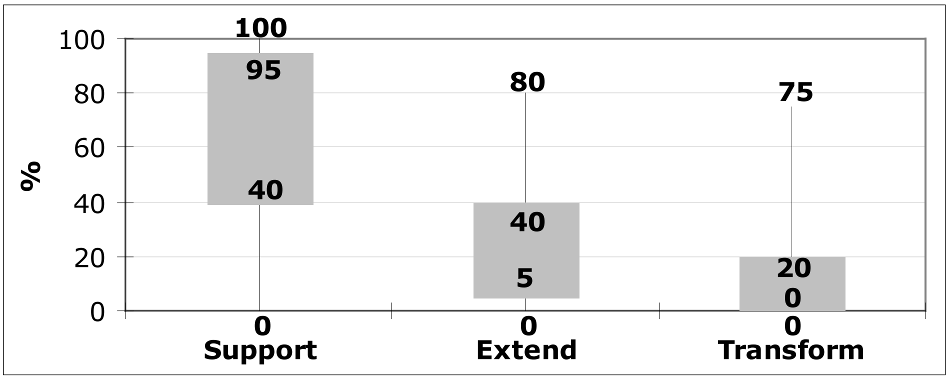
> The content is the same as a classroom activity. The process is essentially different so the Mode is somewhere between Support and Extend.
> (Respondent 13)

This meant that they often placed their cross on the 'scale' part way between two categories, which skewed the analysis of the data.

Scenario 4

This scenario asked the respondents to rate the average Mode over the whole term by indicating the percentage to which each category on the Mode dimension applied (Figure 7.35). This indicated a wide spread of percentages for each of the categories on the Mode dimension, suggesting a lack of inter-operator reliability.

Figure 7.35 Distribution of percentages for each of the Mode categories in Scenario 4 (n=17)



Many of the issues raised in relation to Scenarios 1 to 3 were also mentioned in relation to Scenario 4. In addition, the problems identified in making a judgement for the whole term in relation to the Focus dimension were also raised for the Mode.

Summary

Whilst there did appear to be a sufficient degree of consistency between the respondents in relation to the Quantity dimension this was not the case for the Focus or Mode dimensions. Neither the Focus nor Mode dimensions were consistently applied when comparing across the different respondents. However, no obvious patterns could be identified to distinguish between sub-groups within the respondents either in terms of their background, gender, age, or other characteristics. Indeed there did not appear to be a consistent 'bias' in the pattern of response for any of the respondents individually across the four scenarios.

The only conclusion that could be drawn from this analysis was that the Focus and Mode dimensions were not reliable when being applied to secondary descriptions of computer use. Indeed several of the respondents commented that the difficulties they had encountered were related to the quality of the data rather than the CPF itself:

> As you can see, I felt that in order to use the CPF with confidence, I needed very clear and detailed data. Otherwise, I felt unable to make a judgement. So the CPF itself is fine, in that I could use it where the data allowed.
>
> (Respondent 6)

> I'm not convinced that I can ascribe percentages with any degree of accuracy without actually experiencing the lesson.
>
> (Respondent 9)

The data analysis had however, revealed a number of areas in which the Focus and Mode dimensions could be enhanced. In addition some of the respondents, whilst not asked to do so, made comments that indicated that they thought that the CPF was a valuable tool:

> The strength of the CPF is the vocabulary that it provides to discuss IT activity => I found this helpful.
>
> (Respondent 3)

> Retrospectively I can see a usefulness of the CPF in highlighting for teachers the focus of their ICT planning although I think it requires a lot more material to help in applying it
>
> (Respondent 19)

Modifications to the CPF

In the light of the analysis of the responses to the ITTE survey it was clear that both the Focus and Mode dimensions needed to be further refined. This constituted the final stage in Cycle 3: revising the general idea (see Table 2.8 on p.61). These changes fell into three distinct areas: changes to the definition of an individual dimensions; changes to the inter-relationships between the dimensions; and changes in the way that the CPF should be applied.

Changes to individual dimensions

The Quantity dimension remained unchanged (see Table 7.8 on p.316). The Focus dimension was altered to take into account the differences in interpretation of the meaning of IT that had been evident (see p.329). Specifically the term ICT was replaced in the definition by the term IT and the exemplification for the IT and Learning Tool categories was adjusted (see Table 7.14). The Focus was also changed in order to address the issue of how to categorise an activity where no learning objectives were intended (e.g. filler activities) or achieved (e.g. poor implementation). This was achieved by redefining the Other category, as shown in Table 7.14.

Table 7.14 The revised definition of the Focus dimension

The ***Focus*** deals with the objectives underlying the computer use. The *Focus* dimension is sub-divided into three categories:

IT - **Using computers in a way that helps children to develop their IT[1] skills, knowledge and understanding.** The emphasis here is on using a computer to extend the children's knowledge, understanding or skill in computer use itself.
E.g. Learning how to operate the mouse. Learning how to use the word processing software.

Learning Tool - **Using computers in a way that supports any aspect of children's learning other than *IT* itself.** This would include the following three areas:

> *Curriculum Tool* - Using computers as tools in a way that helps children to develop skills, knowledge and understanding in another curriculum area (i.e. other than IT). The emphasis here is on using the computer as a tool to enhance their learning in another curriculum area rather than in the area of IT itself.
> E.g. To develop the language skills involved in drafting and re-drafting. To extend their ability to interpret data (e.g. using a graphing package that they already know how to operate to help them answer a scientific question). To provide access to the curriculum (e.g. for children with 'Special Needs').
>
> *Mathetic Tool* - Using computers as tools to develop children's ability to learn and enhance their approaches to learning.
> E.g. To encourage collaboration. To help children reflect on their own learning processes. To teach children to teach each other how to use particular programs.
>
> *Affective Tool* - Using computers as tools to support and enhance the affective aspects of children's learning.
> E.g. To develop their confidence and/or self-esteem (for example by allowing a child who may be perceived as 'less able' to teach other children how to use a new program). Using computers to help motivate children.

Other - **Using the computer in a way that is not covered by *IT* or *Learning Tool*.** *Other* thus includes objectives that do not relate directly to learning outcomes and/or where no learning is apparent. Objectives for using computers that fall within this category may be focussed on practical aspects of the learning situation or the larger context in which the computer use is taking place.
E.g. Using computers in order to respond to pressure to do so from children, their parents, colleagues and/or external agencies. Allowing children to use the computer as a reward or holding activity whilst the teacher is working elsewhere. An example of this would be allowing children who have finished other work to 'go on the computer'. Using a computer in order to make the teacher's workload or classroom management easier or more enjoyable. Using computers as a mechanism for presenting the school in a good light or in order to be seen to be using them. *Other* would apply where no learning is evident

The Mode was also revised to reflect the extent to which computer use was impacting on the curriculum (excluding IT) by strengthening the definition of curriculum within it (see Table 7.15). This change was made in the light of comments from the respondents to the inter-operator reliability testing (see p.332).

[1] It is important to distinguish between the term *IT*, which is used here to refer specifically to learning how to operate the hardware and software, and terms such as IT, ICT and C&IT which are used more broadly to include learning about the application of the technologies. Thus *IT* as used here is *not* synonymous with the UK National Curriculum subject called ICT.

Table 7.15 Revisions to the definition of the Mode dimension

The ***Mode*** dimension is concerned with the impact of computer use on the curriculum. The curriculum is taken here to cover all aspects of practice surrounding computer use including:

- content (which incorporates and goes beyond the explicit curriculum as set down in guidelines/curriculum documents but omits the *IT* curriculum - i.e. excluding aspects dealing with how to operate the computer/software);
- processes.

The *Mode* dimension of the CPF is sub-divided into three categories:

Support - Learning objectives (excluding those relating specifically to *IT*) remain the same but the process is automated in some way. *Support* is thus about improving efficiency and effectiveness without changing curriculum content.

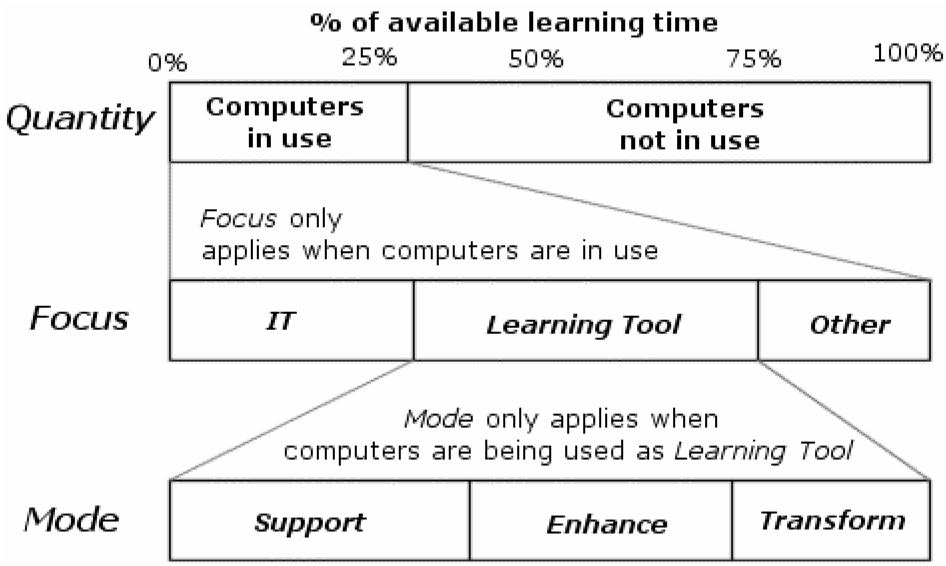
Extend - Curriculum content and/or process are different, but these changes *could* take place in a classroom context *without* a computer.

Transform - Curriculum content and/or process are different, and these changes *could not* have taken place in a classroom context *without* a computer.

Changes to the inter-relationships between the dimensions

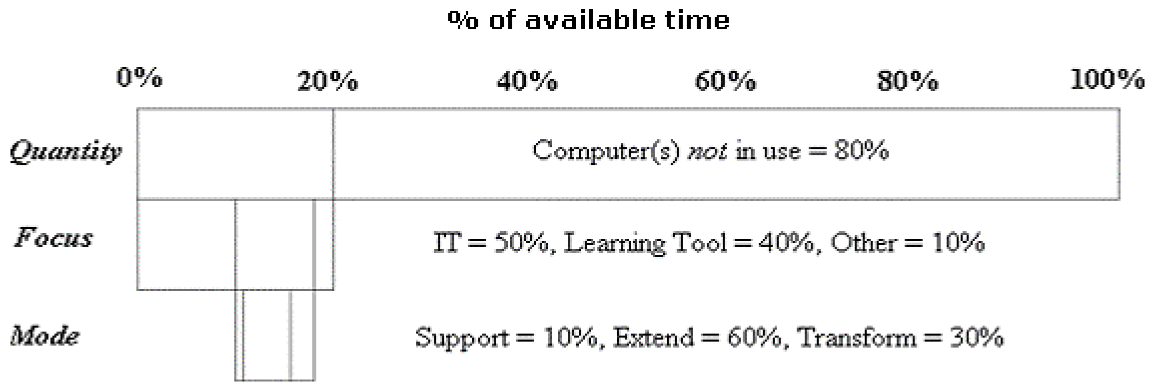
A further change was made to the CPF to reflect the concerns about the extent to which the Mode dimension should apply where no learning (other than about IT) was taking place. The definition of the Mode was changed so that it only applied where the Focus of the activity was Learning Tool. This reflected the notion that where no learning was taking place (other than IT) computer use could not impact on the curriculum. The resultant inter-relationship between the three dimensions of the CPF is represented in Figure 7.36.

Figure 7.36 The revised inter-relationship between the three dimensions of the CPF



Changing the relationship between the Focus and the Mode dimensions also helped to overcome a problem that had arisen in earlier versions of the CPF in relation to the ease with which comparisons could be made across contexts. The early versions of the CPF enabled rapid comparison of different contexts through a simple visual representation (see Figure 5.18 on p.228). This was lost in later versions where the relative degree to which each category on the Focus and Mode dimensions was recorded. However, the latest version of the CPF again lent itself to a form of visual representation which facilitated comparisons across contexts, as illustrated in Figure 7.37.

Figure 7.37 Visual representation of a description of computer use based on the CPF



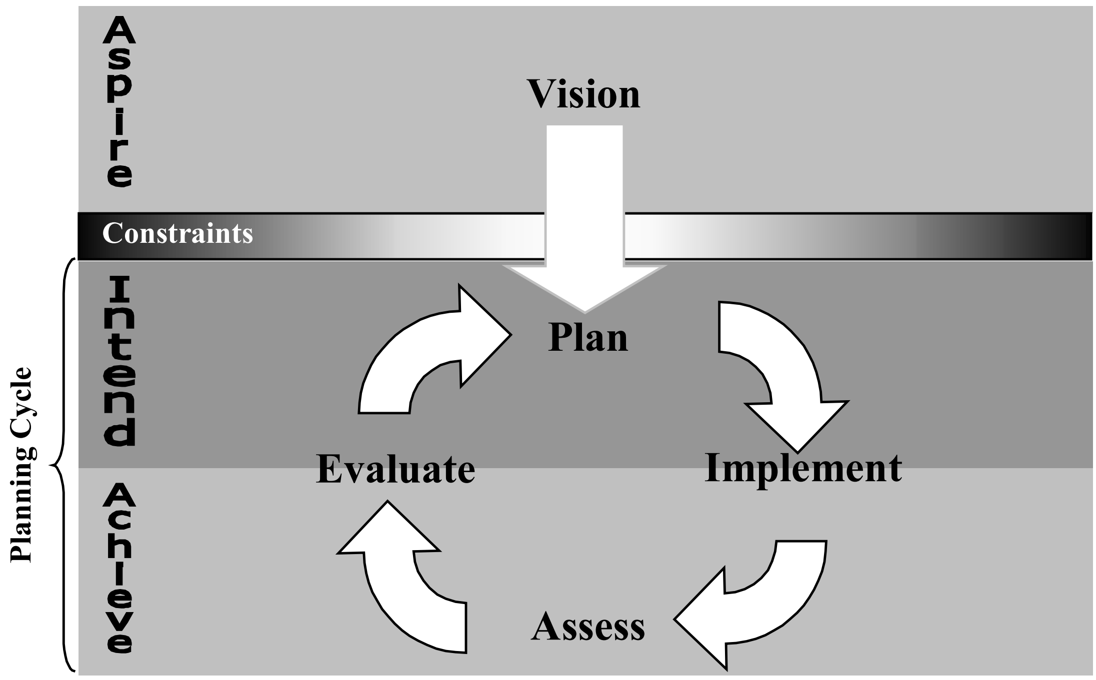
Changes in the way that the CPF should be used

A number of issues were raised by the respondents to the inter-operability reliability testing about how to apply the CPF. The most significant of these, which was explicitly mentioned in relation to the Focus and Mode dimensions, was the issue of whether in applying the CPF emphasis should be given to what the teacher intended or what was actually achieved (see p.329 and p.340). This was an issue that the researcher thought had been dealt with in the wording of the definitions of these two dimensions. For example the Focus dimension had specifically stated that "The Focus deals with the objectives that the computer use sustains, when it is implemented." However, it was clear that this had not been sufficient.

In thinking about how to overcome this problem the researcher identified three different levels at which the CPF could operate, which could be labelled: Aspire; Intend; and Achieve. The Aspire level relates to the vision of what one would like to achieve. Intend relates to what one actually plan to implement and Achieve relates to what is actually implemented.

Pelgrum and Plomp (1991) described the distinction curriculum theories make between intended, implemented and attained curricula, which correspond to three levels within the curriculum development cycle (Figure 7.38). This connection between the levels at which the CPF could operate and the curriculum development cycle highlighted another way in which the CPF could help to overcome the lack of impact of investments in ICT on practice in schools.

Figure 7.38 A diagrammatic representation of the stages in a curriculum development cycle (Twining forthcoming)



In the initial review of the variables obstructing the high level of investment in ICT having a substantial impact on the practice in schools (Chapter 1), one of the key barriers was identified as being a lack of vision about how to use computers. In refocusing this research following the first three case studies the need for shared understandings by everyone involved in a change process was highlighted (Chapter 5). The importance of such shared vision underpinning any planned change is widely reported in the literature (e.g. Fullan 1993; Hargreaves 1994; Talbot 1994; Conlon 2000; Twining 2001b).

Furthermore, if Fullan and Stiegelbauer (1991) are correct when they say that:

> with complex social problems the total number of variables (and their interactive, changing nature) is so large that it is logistically infeasible to obtain all the necessary information, and cognitively impossible for individuals to comprehend the total picture even if the information is available
>
> (p.99)

then even if we could use descriptions of practice based on the CPF to help us identify causal relationships involved in increasing the impact of investments in computer use in schools these would be too complex to be of any practical help. Using the CPF as a flexible framework to support vision building within the change process would be a more powerful approach, which recognises the importance of "establishing a process that will allow us to use the ideas and discover additional ones along the way" (Fullan and Stiegelbauer 1991 p100).

Having such a flexible approach for developing shared visions is particularly important in a context where there is no obvious 'best' option, as is the case for computer use in schools. Moseley *et al*. (1999) identify two conflicting views of the role of computers in schools: helping teachers to do their jobs more effectively and efficiently or transforming teaching and learning. Cuban (2001) re-iterates these two goals for ICT and adds a third: preparing pupils for work in the future. It is clear there is still no consensus between educationalists on what constitute appropriate uses of technology in education (Roblyer 2000). This is perhaps not surprising in a context in which

> No clear, convincing, and unambiguous evidence points like an arrow toward an unavoidable conclusion guiding policymakers, practitioners, or researchers to choose among the scenarios.
>
> (Cuban 1993 para 11)

This lack of clarity of vision about the role that ICT should play in schools is highlighted by conflicts between different government policies within the UK (Selwyn 1999). For example, the requirements of the National Numeracy and Literacy strategies, which focus on whole class teaching, mitigate against the use of computers as a cross curricular tool, which has led to a drop in the quantity of use of computers in schools where the Numeracy and Literacy strategies apply (BECTa 2001a). This lack of a clear and shared vision about the purpose of introducing ICT into schools helps to explain what some perceive as teachers' resistance to change (Mumtaz 2000).

Given the increasingly large amounts of resource being ploughed into ICT in schools (Twining 2002a) the need for shared understandings about the potential impact of those investments and agreement about the intentions behind them has never been greater. The CPF highlights three key questions that can help to provide that clarity (Twining 2001b). They are:

- What are your main objectives for using ICT?
- What impact do you want ICT use to have on the curriculum?
- How much time do you want learners to spend using computers?

The CPF can also be explicitly linked to the curriculum development cycle in a way that can further support the development of shared understandings (Twining forthcoming).

This approach to the use of the CPF as a conceptual tool for thinking about computer use fits the Generative criteria for evaluating frameworks, which was identified in Chapter 5. It also fits Cannon and Lonsdale's (1987) recommendations about how to promote desirable educational change, which included helping individual practitioners to develop conceptual frameworks through which they may better understand their own practice. Used in this way the CPF supports reflection on existing practice by providing guidance about fruitful ways of thinking about that practice. This is qualitatively different to using the CPF to provide a description of practice. Instead it fulfils the need identified by Alvarex and Kilbourn (2002):

> A map is needed that helps point the way but is broad enough to allow for shifts in direction.
>
> (Conclusion para 2)

Chapter 8
Conclusion

The initial problem identified in Chapter 1 was that the high level of investment in computers in education had had little impact on schools. The level of investment in ICT in schools in financial terms has increased still further (Figure 8.1). This has impacted on the number of students per computer, which has continued to decrease since 1992 (Figure 8.2).

Figure 8.1 Estimated total expenditure on ICT in English state schools (1985-1996 figures taken from DfEE (1997); 1998-2001 figures taken from DfES (2001))

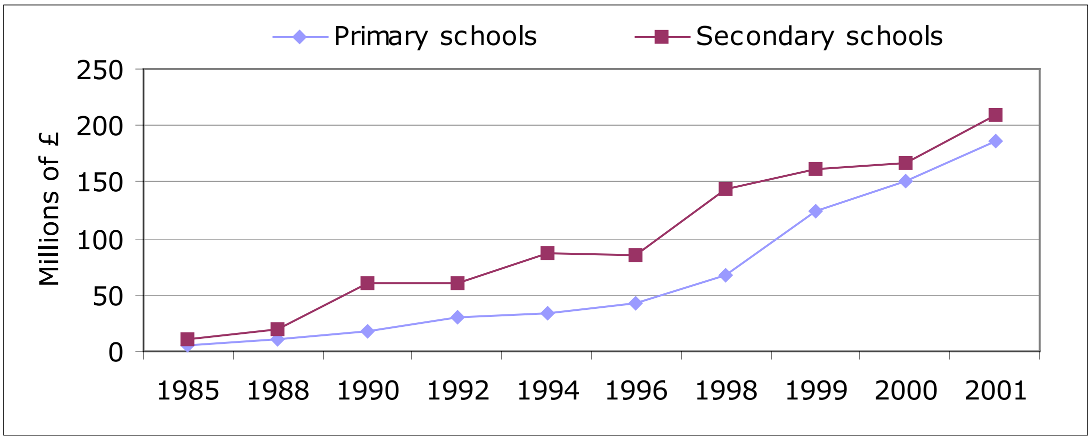
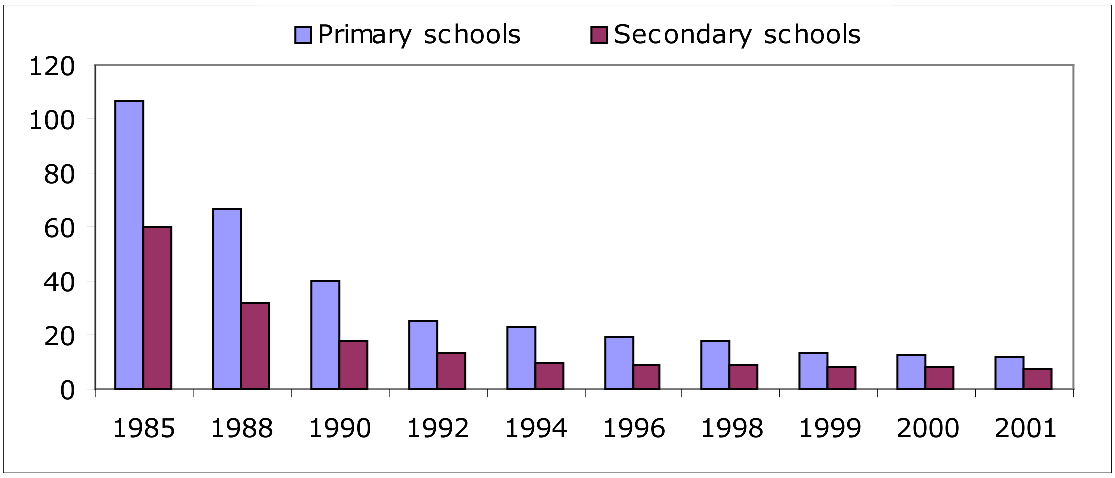


Figure 8.2 Average number of pupils per computer in English state schools (1985-1996 figures taken from DfEE (1997); 1998-2001 figures taken from DfES (2001))



Despite this huge level of investment and associated changes in the level of ICT resourcing in schools the level of impact on children's achievement in ICT has been less than one would expect (Pelgrum 2001) and its impact on learning across the curriculum has been minimal (e.g. Chalkey and Nicholas 1997; Selwyn and Bullon 2000; Cuban 2001; HMI 2001; OFSTED 2001; Smeets and Mooij 2001; Twining 2001b; OFSTED 2002b; 2002c; Resnick 2002; Reynolds 2002). Trilling and Hood (2001) summarise the situation as being one in which

> The gap between what our educational technologies can do and what they are actually doing in everyday classrooms and homes is still very wide.
> (p.24).

This echoed the view of the Stevenson Report (Stevenson, Anderson, Berwin, Heppell, Summers, Whatford and Winkley 1997), which went on to underline the importance of enhancing the use of ICT in schools:

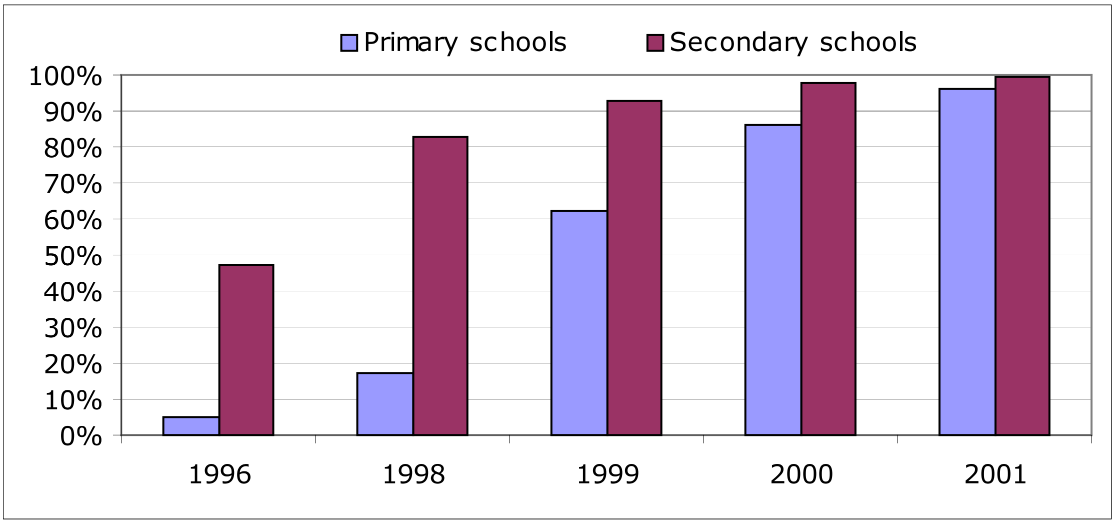
> "if the next government does not take steps to intensify the use of information and communications technology (ICT) in our schools, a generation of children - and a generation of adults as teachers - will have been put at enormous disadvantage with consequences for the UK that will be difficult to reverse."
> (Stevenson 1997 'Our Vision')

This research set out to address the issue of how to increase the impact of investments in ICT in education. The starting point for the research was an exploration of relevant literature (Chapter 1). A proposition emerged from this literature review about one way to enhance the impact of investments in ICT in schools. This proposition was that increasing the quantity and quality of hardware sufficiently to allow a whole group of children to use computers simultaneously would lead to self-sustaining increases in the quantity and quality of computer use.

Since that initial literature review there have been some important changes in the technology, which have impacted on people's perceptions of ICT in education, and which are reflected in the literature. For example, the Internet started to be seen as being of major importance to education, as evidenced by the UK Education Departments Superhighways Initiative (Scrimshaw 1997b; BECTa 1998), the investment in the National Grid for

Learning (NGfL), and the fact that the level of Internet connectivity started to be used as one of the key indicators of the level of investment in ICT in schools in the mid 1990s (see Figure 8.3).

Figure 8.3 Percentage of English state schools connected to the Internet (1996 figures taken from DfEE 1997 (1997); 1998-2001 figures taken from DfES (2001))



Pelgrum and Anderson (2001) argue that the Internet has had a significant impact on schools. In the preface to their report they claim that once schools have connected to the Internet most teachers and many pupils do use it. However, within the report itself they acknowledge that "in many countries the percentage of schools using the Internet/WWW was far below 100%" (p.110) and the strongest conclusion that they could draw was that:

> "a substantial number of students and/or teachers have had at least some experience with the Internet/WWW in the following countries:
> - *Primary education*: Canada, Finland, and New Zealand.
> - *Lower secondary education*: Canada, Denmark, Finland, Iceland, Luxembourg, New Zealand, Norway and Singapore.
>
> (p.110)

This suggests that the Internet is not impacting on learning in schools in the majority of the 26 countries that they studied, and even within the ones that they mention the claim that they are making about impact is very weak. This fits with the predominant view in the literature about the lack of impact of ICT on education that is cited above.

Despite these changes in the technology, re-examination of the recent literature presents a very similar picture to that of the early 1990s. Cloke (2000) argued that even though there has been "extensive research into the use of ICT in schools, relatively little research has focused on the key pedagogical issues." (p.1). This suggests a continued focus on technological issues, despite calls "to expand our concerns to include pedagogical, as well as equipment problems." (Maddux 1993 p.15). Much of the recent research continues to examine the key factors impacting on computer use in education and the interactions between them (e.g. Hoffman 1996; Cox, Preston and Cox 1999; Rogers 2000; Williams 2000; BECTa 2002a). One notable change in the literature is a greater emphasis on computer use in the home (e.g. BECTa 2001a; Johnston 2001), though this also often includes a focus on 'barriers' to computer use (e.g. BECTa 2002b).

Somekh (2000), who reports starting to carry out research on ICT in schools in 1984, seems to agree that the literature within the field has not changed substantially, when she states that "some of the outcomes of this early research were generic, remaining just as true today, despite the enormous changes in the power of the technology." (p.25). Indeed, she goes on to identify a number of key barriers to the use of computers in schools, including the cost of technology and resistance to changes in traditional ways of working in education. In a similar vein Roblyer (2000) identifies variability in the level of resourcing, in terms of equipment, software and staff with appropriate skills, as being a major obstacle to computer use. Notwithstanding their claims about the impact of the Internet on schools, Pelgrum and Anderson (2001) identify the main infrastructural barrier to computer use in schools across the 26 countries that they studied as being an insufficient number of computers. This was reported separately by school principals and by technology co-ordinators, and applied across primary and secondary education. These factors closely mirror those evident in the literature review in Chapter 1, and are typical of the sorts of findings in many recent studies. Thus, the arguments put forward in support of the original proposition that emerged from the literature in Chapter 1 continue to find support in the literature.

The first three case studies provided evidence that suggested that increasing the quantity and quality of resources by adding 5 PowerBooks did impact on the quantity of computer use, and that increasing the quantity of computer use above a minimum threshold did increase the quality of computer use. However, the evidence also showed that these were not straightforward relationships and the proposition as a whole was too simplistic. These case studies also highlighted problems with the criteria used for evaluating the quality of the computer use within them. Exploring this further suggested the need to develop better ways of describing and comparing computer use, as a first step to enhancing the impact of investments in ICT in education.

Simco (1995) argued that it is necessary to have "a manageable research tool which can realistically encapsulate the complexity of social processes within classrooms" (p.49) in order to be able to understand that environment. A framework for describing computer use within education potentially represents one such tool. A number of existing frameworks for thinking about and describing computer use in education were examined, in the light of the first three case studies, in order to establish their strengths and weaknesses (Chapter 4). This led to the development of a set of criteria for evaluating such frameworks (Table 4.30 p.194). It also highlighted the inadequacy of all of the existing frameworks and the need for a new framework, which led to the development of the CPF.

Since that original analysis of existing frameworks was carried out a number of other researchers have also developed new frameworks designed to enhance the impact of investments in computer use in education. For example, Laurillard (1996) described a model for examining the pedagogical implications of changing the balance of media used in learning, which is explicitly linked to the costs of developing the learning materials. This model analyses student study in terms of four modes of activity: attending, practicing, discussing and articulating. Within the model different media are viewed as supporting different proportions of each mode of student activity. For example, paper based materials predominately support attending, whilst computer conferencing supports discussing, and so forth. Twining's (1999) critique of Laurillard's (1996) Media Mix Model illustrates that it, like all software frameworks, suffers from the problem of technological determinism. Software and other technologies have what Laurillard, Stratfold, Luckin, Plowman and Taylor (1999) describe as affordances, that is they lend themselves to being used in certain ways. However, that does not preclude them from being used in other ways, which were not intended or anticipated by their designers. The media (including type of software) does not determine the way in which it is used, and thus any framework based on the type of media is flawed.

Solmon (1998) and Lemke and Coughlin (1998) describe a framework consisting of seven dimensions, which they state can be used to describe progress in implementing/embedding ICT within schools. Lemke and Coughlin (1998) argue that this framework is designed to help the educational community, technology coordinators, policymakers and researchers and can be used: to define expectations (vision); as an assessment tool; as a planning tool; for accountability purposes; and as a research agenda. One of the dimensions of the framework, which looks specifically at the use of the technology with learners, is illustrated in Table 8.1.

Table 8.1 An example of one of the seven dimensions of Solmon and Lemke and Coughlin's (1998) framework (Lemke and Coughlin 1998 p.18)

DIMENSION 1 - LEARNERS In looking at the LEARNERS dimension, we are asking: Are learners using the technology in ways that deepen their understanding of the content in the academics standards and, at the same time, advancing their knowledge of the world around them? **PROFILE: LEARNERS** *FLUENCY*: The student is proficient using technology and communication networks for whatever endeavours he/she chooses. *STRENGTHENING THE BASICS*: The use or technology makes it possible for the student to learn the basics with more depth and understanding. *DEVELOPING HIGHER LEVEL SKILLS*: This use of technology makes it increasingly possible for the student to engage in learning practices that lead to new ways of thinking, understanding, constructing knowledge and communicating results. *INCREASING RELEVANCY*: The student is using contemporary technology, communication networks and associated learning contexts to engage in relevant, real-life applications of academic concepts. His/her work parallels the way in which professionals in the work force use technology. *MOTIVATION TO LEARN*: The quality of access to technology and telecommunications is increasing the intrinsic motivation of the student to learn. *RECOGNITION OF TRADEOFFS*: The student is cognizant of the tradeoffs inherent in the application of technology in society as he/she makes life choices in a global, technological society.

Evaluating this framework against the criteria developed in Chapter 4 reveals that it has a number of major limitations, the key ones of which are described in Table 8.2.

Table 8.2 Major limitations of Solmon (1998) and Lemke and Coughlin's (1998) framework

Criteria	Description of problem
Simplicity & wholeness	The seven dimensions within the Lemke & Coughlin (1998) framework each divide into a substantial number of sub-dimensions: six in the case of the Learners dimension (see Table 8.1). The framework lacks a coherent conceptual structure and there is little attempt to synthesise overarching dimensions of the practice that the framework is attempting to describe or to articulate the actual nature of the inter-relationships between the dimensions or their sub-components. Thus, rather than affording a coherent overview of practice this framework provides a large number of discrete dimensions, which makes it difficult to identify useful patterns within them.
Ambiguity & accuracy	The dimensions (and often their sub-components) are often only loosely defined, as can be seen within Table 8.1. This makes it difficult to apply them and reduces the consistency of the descriptions that they produce (e.g. reliability).
Value Laden & Internal consistency	The dimensions within the framework are superimposed with value judgements about what constitutes 'high quality' practice, but there are apparent contradictions within this. For example, there is a tension between 'strengthening the basics' and 'developing higher level skills' within the Learners dimensions (Table 8.1).

In addition to the new frameworks that fit within the original classification of such frameworks provided in Chapter 4 a new category of frameworks has started to be developed, which might best be described as Achievement Frameworks. The Measurement of the Impact of ICT on Children's Education framework (MIICE, van der Kuyl 2001b) is currently the best example of this type. As its name suggests, MIICE explicitly sets out to provide measures of quality in learning with ICT (see Table 8.3 for an extract from MIICE).

Table 8.3 An extract from the MIICE framework (based on van der Kuyl 2001a p.27)

<table>
<tr><td colspan="2">Outcome: Learner reflection [1]</td><td colspan="2" align="right">Level: 2</td></tr>
<tr><td colspan="4">This relates to learners' ability to think about what they are doing, and their ability to put it into a number of contexts</td></tr>
<tr><td colspan="4">1 Taking personal responsibility for learning
1 Can learners use self-assessment reliably and use the results to decide on their next steps?
2 Are learners able to resume work from previous activity on their own initiative?
3 Is learners' use of ICT usually closely related to the purpose of the exercise?
4 Are learners able to contribute to a project from their own interests?
2 Realistic but improving culture
1 Do learners show an interest in going beyond the minimum standards for the task in hand?
2 Do learners show an interest in comparing different ways in which ICT can be applied?
3 …..
4 …….
…….</td></tr>
<tr><td>Evidence at ages 5 to 14: Learners
1.1 can check their program against simple criteria before deciding what to do next
1.2 get on with their work from a previous session without fuss
1.3 stick to the point most of the time
1.4 …..
….
4.3 …</td><td colspan="2"></td><td>Evidence at ages 12 to 18: Learners
1.1 are able to use a log to assess their progress through a scheme of work using the computer
1.2 get on with their work from a previous session without fuss
1.3 stick to the point most of the time
1.4 …..
…..</td></tr>
</table>

Unlike most other frameworks relating to computer use in education the MIICE framework has undergone extensive developmental testing with hundreds of teachers, and an attempt was made to validate all of the dimensions within it. Ignoring possible methodological flaws with that validation process, the MIICE framework still suffers from some major problems in relation to the evaluation criteria, as illustrated in Table 8.4.

Table 8.4 Major limitations of the MIICE framework

Criteria	Description of problem
Simplicity	The MIICE framework consists of 13 dimensions, each of which corresponds to a potential learning outcome related to ICT use. For each dimension there are between 2 and 4 sub-dimensions, giving a total of 41 dimensions in total. For each of these sub-dimensions there are sets of questions, which are categorised as being at Level 2 or Level 4. For each of these there are also statements about what would constitute evidence for children in two different age ranges (see Table 8.3). This results in over 200 individual questions and over 400 statements of evidence. It is immediately clear that MIICE does not meet the *simplicity* criterion.
Ambiguity & accuracy	The definitions of the dimensions, their sub-dimensions, the associated questions and evidence are often ambiguous (see Table 8.3). This reduces the consistency of the descriptions that they produce (e.g. reliability).
Discreetness	The dimensions of the framework are not orthogonal: "some of the components in the MIICE toolbox deliberately appear in more than one outcome. There are also many links between components across the framework. In this way, the MIICE toolbox reflects the 'messy' reality of learning." (van der Kuyl 2001a p.53)

In the light of these important problems with the utility of all the frameworks that have been developed it is clear that the need for a suitable framework for describing and thinking about computer use in education still exists, and the development of such a framework would constitute an important contribution to the field.

The CPF initially emerged from case studies 1-3, and was revised through a series of cycles (see Tables 2.8 & 2.9) involving its evaluation in a range of contexts, peer review, and reflection informed by the literature and experience. Throughout this process the notion of utility, which underpins action research (Elliott 1991), was paramount. The intention was to develop a practical tool to enhance the impact of investments in ICT, using an interpretivist approach to research.

Case studies 4 and 5 highlighted questions about the validity and reliability of the CPF, leading to further fieldwork and evaluation of it. Case Study 6 reinforced the concerns about the reliability of the CPF, and hence its validity. The subsequent reliability testing, although it had some important methodological limitations, provided further evidence that the CPF was not reliable, in the sense that different people produced different descriptions based on the CPF when applying it. However, in the process of evaluating the CPF it became clear that using it as a conceptual tool for thinking about and analysing computer use, as part of a planning or curriculum development process, would be an even more productive approach to enhancing the impact of investments in educational ICT.

Lemke and Coughlin (1998) argue that their framework is designed to help the educational community, technology coordinators, policymakers and researchers. These categories correspond to different groups of stakeholders at different levels within the education system (see Table 8.5). All of the levels in Table 8.5 are important if significant change is going to occur (Fullan and Stiegelbauer 1991), and it is clear from the literature that there is strong support for the view that significant change is necessary if computers are going to be used effectively in education (e.g. Ridgway and Passey 1995; Riffel and Levin 1997; Scrimshaw 1997a; Gage 2002; Resnick 2002).

Table 8.5 Mapping key stakeholders onto levels within the education system

<table>
<tr><th>Level</th><th colspan="2">Lemke & Coughlin's stakeholders</th><th colspan="2">Key stakeholders</th></tr>
<tr><td rowspan="2">National and regional</td><td rowspan="7">Researchers</td><td rowspan="2">Policy makers</td><td>Politicians</td><td rowspan="7">Researchers</td></tr>
<tr><td>Funders</td></tr>
<tr><td rowspan="2">School or institutional</td><td rowspan="2">Technology co-ordinators</td><td>Senior Managers</td></tr>
<tr><td>Technology co-ordinators</td></tr>
<tr><td rowspan="3">Class or individual</td><td rowspan="3">Education community</td><td>Teachers</td></tr>
<tr><td>Pupils</td></tr>
<tr><td>Parents</td></tr>
</table>

Lemke and Coughlin (1998) go on to argue that their framework can be used in a range of different ways by these stakeholders, including: to define expectations (vision); as an assessment tool; as a planning tool; for accountability purposes; and as a research agenda. Similar claims can be made for the CPF both in terms of the levels at which it can be applied and the purposes for which it can be used.

In the discussion of vision building within Chapter 1 the importance of developing shared goals for planned changes was emphasised (pp.31-33). In Chapter 7 this was reinforced in relation to computer use in schools (pp.348-350). It is clear that there is confusion about the underpinning aims for using computers in schools (e.g. Roblyer 2000) and that there is a need to develop shared visions of the role of computers in education in order to enhance the impact of investments in educational ICT (e.g. Hexel, De Marcellus and Bernoulli 1998; Conlon 2000). Part of the problem is that the motivation for investing in ICT in schools is often politically rather than educationally driven (e.g. Stoll 2000) and thus ignores the concerns of educators (e.g. Olson 2000). This often leads to conflicts in goals and inappropriate implementation, leading many to argue that any vision for ICT use in education should be based on consideration of the purposes of education and the nature of teaching and learning (e.g. Riffel and Levin 1997; Cuban 2001; Conlon 2002).

The CPF can help the process of developing shared visions at all levels within the education system in two key ways (see Twining (2001b) for a fuller account of how the CPF can support vision building). Firstly, it can help individuals to think about the purposes that they think computers should fulfil (the Focus dimension) and the impact that they think that they should have (the Mode dimension). Secondly, it can support the development of shared visions by providing a coherent structure and clearly defined terminology, which supports communication between all the different stakeholders. This is vital, as effective communication is a crucial vehicle to help those involved in education to develop clear understandings of the meanings of proposed changes, and therefore underpins successful innovation in education (Fullan 1996).

Developing a vision, which is an idealised view of what one would like to achieve, forms part of the curriculum development process (see Figure 7.38 on p.347). As such, one's vision links with one's planning and assessment. McDougall and Squires (1997) identify that there is "a need for suitable models and theoretical frameworks to assist planning and assessment" (p.115), and the CPF is one such framework (see Twining (forthcoming)) for a fuller account of how the CPF can support curriculum development).

"The starting point in planning any activity is a clear understanding of the learning outcomes the teacher wants to achieve" (McFarlane 1997). Thus, within the planning stage of the curriculum development cycle one has to modify one's idealised objectives (vision) in the light of prevailing constraints. The Focus dimension of the CPF highlights the need at this stage to clearly distinguish between objectives that relate to learning about the technology, those that relate to using the technology as a tool to support learning in other subjects, and other objectives, which may be more pragmatic. For those objectives that relate to using the computer as a tool to support learning in other subjects, the Mode highlights that ICT can support, extend or transform these objectives. Each of these has different implications in terms of the level of resourcing required (which has links to the Quantity dimension), the way in which an activity needs to be implemented, and the assessment strategies that should be used. One's objectives have implications for the management and use of resources (see (Twining and Richards 1999; Twining 2001b) for more details), and for the levels of staff confidence, competence and understanding of how to use computers in education (Scrimshaw 1997b; Twining and McCormick 1999).

Assessment is concerned with what has been learnt (Tolley 1989) and as such the assessment should be linked to the intended learning objectives (Twining and Richards 1999). As was the case with planning, the Focus dimensions of the CPF helps to distinguish between objectives relating to learning to use the technology and learning in other subjects. In this latter case the Mode dimension highlights the importance of distinguishing between the learning content and processes. This is very important when assessing learning outcomes relating to the use of ICT as a Learning Tool, because "ICT does not just alter the products that derive from children's learning activities but also often impacts on the processes through which learning takes place." (Twining forthcoming p.11). This has implications at all three levels in Table 8.5, and is a particular problem in relation to ICT use in education as was shown in Chapter 1 (pp.1-2).

Evaluation is the next stage in the curriculum development cycle (Figure 7.38 on p.347). One role of evaluation is to feed into subsequent planning (Twining and Richards 1999), but it can also be used to provide evidence for accountability purposes. The CPF provides a structure within which to collect evidence and as such can support and enhance evaluation.

One of the original drivers for developing the CPF was to develop a coherent shared framework for describing computer use in education in order to overcome the confusion that was evident in the literature (see Chapter 4 pp149-151). Whilst the apparent lack of reliability of the CPF prevents it being used to compare practice in different contexts, it does still provide a coherent framework for thinking about and categorizing research in this field. For example, one of the confusions in the literature is whether a particular study is concerned with learning about the technology or using the technology to support learning in other areas. Classifying studies according to their Focus would help to overcome this problem.

In addition, the CPF highlights a number of areas worthy of further study. For example, computer use that fits within the Extend category on the Mode dimension involves changes in the content and/or processes of learning, which could have been achieved without the technology. An important area that needs to be examined is the extent to which it would be more cost effective to bring about those changes with or without the technology.

Inevitably, there is also scope for further research to enhance the impact of the CPF on investments in ICT in education. For example, whilst the CPF was mainly developed in primary schools it has been used effectively to inform the development of an undergraduate course (Twining 2001a). However, further work is needed to explore the range of contexts in which it can usefully be applied. Similarly, whilst it is clear that the

CPF can support innovation and curriculum development, further work on the most effective ways of implementing it would be valuable.

More speculatively, additional research on the use of the CPF as a framework for describing and comparing computer use across contexts would be valuable. If the changes made to the CPF following the final round of reliability testing were found to have enhanced its reliability and validity that would re-open the possibility of using the CPF as a framework that enabled changes in computer use to be identified. This would provide a second way of using the CPF, which would enhance its overall contribution to the field.

There may also be scope to use the CPF as a conceptual tool to support innovation in other areas. The level of abstraction of the framework means that it is not specifically tied to any particular technology. Each of the dimensions could potentially be equally well applied to other innovations. For example, the CPF could have been used in the past to think about the introduction of pencils to schools. In this case, the use of pencils could have been analysed in terms of the quantity of use, the purposes underpinning that use (to learn how to use a pencil, to use the pencil as a tool to support learning in other areas, to use pencils for some other reason), and the impact that using pencils would have on learning. Similarly, it may be that the CPF, or a close derivative of it, may have the potential to enhance investment in innovations in areas other than education. Clearly, further work would be needed in order to substantiate these speculations.

Overall, the CPF is a new framework that can help all those involved in education to think more clearly about the use of ICT. In this way it can inform decisions about investments in ICT in education and help to ensure that those investments achieve their intended goals. As such the CPF represents an important contribution to enhancing the impact of investments in ICT in education. Further evidence to support this view comes from the publications based on the CPF (see p.xvii) and from its uptake by senior managers, researchers and practitioners (see Appendix Q).

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Appendix A
Case Studies 1 to 3 – Manual Log

Teacher's Name

County Primary School Computer Record Sheet

Computer's identity (e.g. Green PowerBook in 5DS)

Date	Start time	End time	Who (Name and Class)	Disc	What

Appendix B
Case Studies 1 to 3 – ITTE student IT competence questionnaire

IT Questionnaire

Please fill in this questionnaire in order to provide some background information about yourself in relation to computers and IT generally.

The information collected will only be used for research purposes and your name will not be used in any report of that research.

Section 1

Surname ____

First name ____

Date ____________________

If you hold a post of responsibility what area(s) is it in?

____

How long have you been teaching? ____________________

How long have you been at this school? ____________________

Have you been on any IT related INSET? Yes / No

Section 2

On the following scale circle 1 if you strongly agree with the statement, circle 5 if you strongly disagree, or circle a number between if your opinion is less extreme. Answer the questions quickly, a considered reply is not required. Always circle ONE number on each line.

		Your opinion Agree <----> Disagree
1.	Computers are unfriendly	1 2 3 4 5
2.	Computers stimulate learners to think for themselves	1 2 3 4 5
3.	Computers are threatening	1 2 3 4 5

Peter Twining : Questionnaire 1 1

Section 2 cont.

		Your opinion Agree <----> Disagree
4.	All teachers should use computers	1 2 3 4 5
5.	Computers take over from people	1 2 3 4 5
6.	Computers should be kept to a specialist topic	1 2 3 4 5
7.	Computers are frightening	1 2 3 4 5
8.	Slow learners find it difficult to use computers	1 2 3 4 5
9.	The computer allows personal feedback to the user	1 2 3 4 5
10.	Computers distract children from real work	1 2 3 4 5
11.	Teachers need to adapt the use of computers so that they fit naturally in to the course of study	1 2 3 4 5
12.	Computers stifle creativity amongst children	1 2 3 4 5
13.	Most teachers should have a computer for personal use	1 2 3 4 5
14.	Computers are over-rated as a means of teaching people	1 2 3 4 5
15.	Computers make people think more about the topics that they are learning	1 2 3 4 5
16.	I want to know how a computer works inside, rather than just 'drive' it	1 2 3 4 5
17.	I want to use a computer when I teach my specialist subject(s)	1 2 3 4 5
18.	I want to use computers for administrative tasks	1 2 3 4 5
19.	I feel confident in my ability to use computers in education	1 2 3 4 5
20.	I feel anxious if asked to work on a computer	1 2 3 4 5
21.	I have some keyboard (typing) skills	1 2 3 4 5
22.	Computers are an important part of teacher education	1 2 3 4 5
23.	I have a positive attitude to computers	1 2 3 4 5
24.	I can use a computer for personal tasks	1 2 3 4 5
25.	Computers make things easy to learn	1 2 3 4 5
26.	I am familiar with the National Curriculum requirements for IT	1 2 3 4 5

Peter Twining : Questionnaire 1 2

Section 3

Please rate your competence on the following scales. Circle 1 if you feel unable. Circle 5 if you are expert. If you have some competence use a number in between. Please circle ONE number on each line.

		Competence Unable <---> Expert
1.	To load and run a computer program	1 2 3 4 5
2.	To prepare a new floppy disc	1 2 3 4 5
3.	To use a word processor to produce a page of text	1 2 3 4 5
4.	To copy a disc or computer file	1 2 3 4 5
5.	To use a computer to enhance text using size and typeface alterations	1 2 3 4 5
6.	To use a computer to sort and select information	1 2 3 4 5
7.	To use a computer to manipulate lists or tables of numbers	1 2 3 4 5
8.	To use a computer to produce graphs or charts	1 2 3 4 5
9.	To use a computer to produce or manipulate pictures	1 2 3 4 5
10.	To use a computer to create or manipulate music	1 2 3 4 5
11.	To use a computer to control a robot or other device	1 2 3 4 5
12.	To use a computer to send messages	1 2 3 4 5
13.	To use a computer to capture data	1 2 3 4 5
14.	To use a computer to design something	1 2 3 4 5
15.	To use a computer for personal tasks	1 2 3 4 5
16.	To use a computer for administrative tasks	1 2 3 4 5
17.	To appreciate the effects of computers on society and ethics	1 2 3 4 5
18.	To use a word processor to draft and re-draft text	1 2 3 4 5
19.	To use a computer to store, sort and select information	1 2 3 4 5
20.	To use a computer in a modelling or simulation activity	1 2 3 4 5

□

Peter Twining : Questionnaire 1 3

Section 4

How long ago did you first use a computer? ____________________
(Please enter the number of months, put 99 if it was so long ago you can't remember)

In this section please give an indication of your frequency of use of computers. Never (1); rarely (2); on average monthly (3); weekly (4); daily or intensively sometimes (5). If your experience was some years ago still complete the frequency questions, it is relevant.

1.	Frequency of use of a computer at School	1	2	3	4	5
2.	Frequency of use of a computer with children	1	2	3	4	5
2.	Frequency of use of a computer at home	1	2	3	4	5
3.	Frequency of use of a computer in further or higher education	1	2	3	4	5
4.	Frequency of use of a computer in any prior employment you may have had	1	2	3	4	5
5.	Frequency of use of computer in any other context	1	2	3	4	5

Thank you for taking the time and trouble to fill this in.

Peter Twining

Peter Twining : Questionnaire 1 4

Results of the ITTE student IT competence questionnaire

Section 1	**Head**	**T1**	**T2**	**Mrs Humphries**	**T4**	**Mr Jones**	**Mrs Smith**	**T7**	**Mean**
If you hold a post of responsibility what area(s) is it in?	Head	English	Geog & SEN	Assessment		Music	Maths	PE & RE	
How long have you been teaching?	23	20	19	18	1	4	6	20	**13.88**
How long have you been at this school?	5	2	4	12	1	1	3.5	11	**4.94**
Have you been on any IT related INSET?	Yes	No	Yes	Yes	Yes	No	Baker Day	Yes	

Continued on next page

	Section 2	Head	T1	T2	Mrs Humphries	T4	Mr Jones	Mrs Smith	T7	Mean	SD
1	Computers are unfriendly	1	3	3	3	1	3	3	3	**2.5**	0.93
2	Computers stimulate learners to think for themselves	2	3	2	4	4	2	1	3	**2.63**	1.06
3	Computers are threatening	5	3	3	2	1	3	5	3	**3.13**	1.36
4	All teachers should use computers	1	1	5	3	1	2	5	2	**2.5**	1.69
5	Computers take over from people	5	3	5	4	4	5	5	4	**4.38**	0.74
6	Computers should be kept to a specialist topic	5	5		4	4	5	5	4	**4.57**	0.53
7	Computers are frightening	5	3	5	2	1	2	5	3	**3.25**	1.58
8	Slow learners find it difficult to use computers	5	5	5	4	4	5	5	4	**4.63**	0.52
9	The computer allows personal feedback to the user	3	2	2	3	3	4	5	3	**3.13**	0.99
10	Computers distract children from real work	5	5	5	4	4	5	5	4	**4.63**	0.52
11	Teachers need to adapt the use of computers so that they fit naturally in to the course of study	1	1	1	2	1	2	1	2	**1.38**	0.52
12	Computers stifle creativity amongst children	5	2		4	3	5	5	5	**4.14**	1.21
13	Most teachers should have a computer for personal use	3	1	3	3	5	4	5	2	**3.25**	1.39
14	Computers are over-rated as a means of teaching people	5	3	4	2	4	2	1	2	**2.88**	1.36
15	Computers make people think more about the topics that they are learning	3	3		4	3	4	4	4	**3.57**	0.53
16	I want to know how a computer works inside, rather than just 'drive' it	5	5	4	3	5	4	5	5	**4.5**	0.76
17	I want to use a computer when I teach my specialist subject(s)		3		3	1	3	3	3	**2.67**	0.82
18	I want to use computers for administrative tasks	1	1		4	4	4	4	1	**2.71**	1.60
19	I feel confident in my ability to use computers in education	3	5	5	4	5	4	2	5	**4.13**	1.13
20	I feel anxious if asked to work on a computer	3	5	4	2	1	2	5	4	**3.25**	1.49
21	I have some keyboard (typing) skills	1	5	5	5	1	2	2	3	**3**	1.77
22	Computers are an important part of teacher education	3	3	2	3	1	2	3	2	**2.38**	0.74
23	I have a positive attitude to computers	3	4	5	4	5	3	5	4	**4.13**	0.83
24	I can use a computer for personal tasks	1	5	5	5	3	3	5	3	**3.75**	1.49
25	Computers make things easy to learn	3	3	3	3	3	4	5	4	**3.5**	0.76
26	I am familiar with the National Curriculum requirements for IT	2	3	3	3	3	3	5	2	**3**	0.93

	Section 3	Head	T1	T2	Mrs Humphries	T4	Mr Jones	Mrs Smith	T7	Mean	SD
1	To load and run a computer program	3	2	4	4	1	3	4	4	**3.125**	1.13
2	To prepare a new floppy disc	3	1	1	2	1	1	4	4	**2.125**	1.36
3	To use a word processor to produce a page of text	3	2	4	3	5	3	4	4	**3.5**	0.93
4	To copy a disc or computer file	3	1	3	2	2	1	3	4	**2.375**	1.06
5	To use a computer to enhance text using size and typeface alterations	3	1	3	2	3	2	3	3	**2.5**	0.76
6	To use a computer to sort and select information	3	1	1	1	2	3	2	3	**2**	0.93
7	To use a computer to manipulate lists or tables of numbers	2	1	1	1	1	3	2	3	**1.75**	0.89
8	To use a computer to produce graphs or charts	2	1	1	2	1	2	2	3	**1.75**	0.71
9	To use a computer to produce or manipulate pictures	2	1	1	2	2	3	2	2	**1.875**	0.64
10	To use a computer to create or manipulate music	1	1	2	2	1	3	2	2	**1.75**	0.71
11	To use a computer to control a robot or other device	1	1	2	2	1	1	3	2	**1.625**	0.74
12	To use a computer to send messages	2	1	1	1	1	1	2	4	**1.63**	1.06
13	To use a computer to capture data	2	1	1	1	1	2	2	3	**1.63**	0.74
14	To use a computer to design something	2	1	1	1	1	1	2	2	**1.38**	0.52
15	To use a computer for personal tasks	4	1	1	1	2	1	2	2	**1.75**	1.04
16	To use a computer for administrative tasks	4	1	1	1	1	1	2	2	**1.63**	1.06
17	To appreciate the effects of computers on society and ethics	5	1	3	2	3	2	4	3	**2.88**	1.25
18	To use a word processor to draft and re-draft text	4	2	3	3	4	3	4	3	**3.25**	0.71
19	To use a computer to store, sort and select information	3	1	1	1	4	2	2	2	**2**	1.07
20	To use a computer in a modelling or simulation activity	1	1	1	1	1	1	4	2	**1.5**	1.07
	Mean	2.65	1.15	1.8	1.75	1.9	1.95	2.75	2.85	**2.1**	0.59

Section 4		Head	T1	T2	Mrs Humphries	T4	Mr Jones	Mrs Smith	T7	Mean
1	Frequency of use of a computer at School	4	2	4	4	2	2	3	3	**3**
2	Frequency of use of a computer with children	4	2	4	4	2	2	3	3	**3**
3	Frequency of use of a computer at home	3	2	1	1	2	1	1	4	**1.88**
4	Frequency of use of a computer in further or higher education	1	1	1	1	1	2	5	1	**1.63**
5	Frequency of use of a computer in any prior employment you may have had	1	4	1	1	4	1	1	1	**1.75**
6	Frequency of use of computer in any other context	1	1	1	1	2	1	1	1	**1.13**

Appendix C
Case Studies 4 & 5 – Manual Log

Brookdale Combined School

5SL's Computer Log

Monday January 19th 1998

Monday

Who	When (How Long)			Why (focus)	What (mode)	
Who was working on the computer?	When did you start?	When did you finish?	How long did you spend? (mins)	Why were you using the computer?	What program(s) did you use?	What did you do?

5SL Monday 19th January

Appendix D
Case Studies 4 & 5 – Teachers' Questionnaire

Case study 5 TH

Teacher's Questionnaire A

This questionnaire asks you to rate or rank a range of aspects of your 'classroom practice'.

Throughout the entire questionnaire the focus is on computer related activities. Don't worry if what happens in the context of computer related activities is different to what happens in other contexts.

The questionnaire is divided into sections, each of which deals with a different aspect of your 'classroom practice' as it relates to computer use in your class. The sections starts with a brief description of what is included within that aspect of classroom practice and how it can be categorised (for the purposes of this research). You are then given one or more questions to answer in each section.

Questions take three basic forms:

Enter rough numerical values in the spaces provided.

Indicate the extent to which each category applies.

Select the (ONE) category which best describes your practice.

Each question clearly indicates which type of response is required.

Please feel free to write comments on the questionnaire as you fill it in. In particular, if any aspect of the questionnaire is unclear or could be improved please indicate this.

Any notes which would help with the interpretation of your responses would also be very welcome.

I would be grateful if you could complete this questionnaire by Friday Feb 6th at the latest.

Thanks.

Peter T
30.1.98

Teacher's questionnaire A v3 Page 1

Case study 5 TH

Quantity of computer use

1. **For how much of the school day would one of more computers be in use by children from your class/group?**

Range Minimum mins per day ______________

Maximum mins per day ______________

Average (mins per day) ______________

2. **How many minutes of computer use do children from your class/group have per day? (ie sum of time spent on each computer each day)**

Eg 1 acorn used on average for 30 mins per day plus 1 pocket book used on average for 20 mins per day would give an average figure of 50 mins per day.

Range Minimum mins per day ______________

Maximum mins per day ______________

Average (mins per day) ______________

3. **How would you describe the way in which the use of computers is distributed within your class? (Circle ONE descriptor)**

Evenly spread / intensive blocks / regular timetabled sessions / sporadic / none

4. **How would you rate the quantity of computer use by your class/group on the scale below (select best descriptor).**

None **Some** **Quite a lot** **Lots**

5. **Indicate what you would consider to be reasonable interpretations of the words None, Some, Quite a lot, and Lots in this context?**

	Minimum quantity (mins per day)	Maximum quantity (mins per day)
None		
Some		
Quite a lot		
Lots		

Teacher's questionnaire A v3 Page 2

Case study 5 TH

Focus of computer use

Focus deals with the intentions behind computer use in your classroom. There are three possible foci:-

Pragmatic - practical or managerial reasons for using the computer. Not focused on learning but on some other aspect of the classroom situation.
Eg1 Using IT in order to be seen to be using it.
Eg2 Allowing children to use the computer as a reward or filler activity.

Computing - using the computer in order to extend the children's knowledge, understanding or skill in computer use. ie to learn about some aspect of the computer or how to operate it.
Eg1 Using the computer in order to learn how to operate the mouse.
Eg2 Using the computer in order to learn how to use the word processing software.

Learning - using the computer to support the children's learning is some area other than computing.
Eg1 To help them learn about drafting and re-drafting.
Eg2 To extend their ability to interpret graphs.

All three foci will apply to some extent if you are using the computer (even if the extent to which they apply is None!).

6. **Indicate the extent to which each focus applies to your computer use (on average).** (ie Circle ONE descriptor IN EACH ROW which says how much that focus applies)

Pragmatic	None	Some	Quite a lot	Lots
Computing	None	Some	Quite a lot	Lots
Learning	None	Some	Quite a lot	Lots

7. **Indicate what you would consider to be reasonable interpretations of the words None, Some, Quite a lot, and Lots in this context?**

	Minimum % to which it applies	Maximum % to which it applies
None		
Some		
Quite a lot		
Lots		

Teacher's questionnaire A v3 Page 3

Mode of computer use

Mode deals with the actual implementation of computer use in your classroom - how the computer is used. There are three possible modes of computer use:

Repetition - where the computer is being used to repeat something which the children already 'know/understand/can do' (either on or off the computer). ie The children are repeating an activity which they have done before (though the context previously may not have been on the computer).
Eg1 Drawing a bar chart when you already know how to draw a bar chart by hand.
Eg2 Drawing a bar chart when you have already learnt how to draw a bar chart on the computer (even if you do not know how to draw one by hand).

Replacement - where the computer is being used to do something which the children have not done before (either on or off the computer) and which could have been done without a computer.
Eg Learning how to draft and re-draft a story (when they have never learnt how to do this before either on or off the computer).

Extension - where the computer is being used to do something which could not have been done without a computer (eg sending an email) or which would not have been done if it were not for the computer in the context of your class (eg explicitly teaching the children how to teach each other).

All three foci will apply to some extent if you are using the computer (even if the extent to which they apply is None!).

8. Indicate the extent to which each mode applies to your computer use (on average). (ie Circle ONE descriptor IN EACH ROW which says how much that mode applies)

Repetition	None	Some	Quite a lot	Lots
Replacement	None	Some	Quite a lot	Lots
Extension	None	Some	Quite a lot	Lots

9. Indicate what you would consider to be reasonable interpretations of the words None, Some, Quite a lot, and Lots in this context?

	Minimum % to which it applies	Maximum % to which it applies
None		
Some		
Quite a lot		
Lots		

Case study 5 TH

Curriculum content

This section is trying to get at the extent to which computers impact on the content of the curriculum as a whole in your class. (This question is not just looking at the curriculum as it applies to computer use).

There are three levels of impact that the computer may have on the content of the curriculum in your class:

No impact - where the computer does not have any affect whatsoever on the curriculum within your class. (This will only apply if you do not use computers at all - even then it may not apply!)

Plus IT - where the computer adds new content in the form of IT skills, knowledge and/or understanding, but does not affect the curriculum in any other way.

Plus other - where the computer not only adds new content in the form of IT skills, knowledge and/or understanding but also changes some other aspects of the content of the curriculum.

Eg1 It may add additional content to the mathematics curriculum (such as new data handling skills).

Eg2 It may remove content from the science curriculum (such as learning how to operate a ticker tape timer).

10. Indicate which of these descriptors best describes the impact of computers on the content of the curriculum in your classroom.
(Circle ONE item only)

No impact Plus IT Plus other

Teacher's questionnaire A v3 Page 5

Case study 5 TH

Progression

This section is trying to get at the extent to which computers impact on children's progression through the curriculum in your class. (This question is not just looking at the curriculum as it applies to computer use).

There are three ways in which the computer may have an impact on progression within the curriculum in your class:

No impact - where the computer does not have any affect whatsoever on children's progression within the curriculum.

Alters speed - where the computer alters the speed with which children progress through the curriculum.

Eg1 The children may take longer to learn how to write neatly as a result of using a computer.

Eg2 The children may learn how to choose the most appropriate way to analyse a set of data more rapidly through the use of a computer program which allows them to explore the differences between a range of data analysis techniques.

Alters order - the computer alters the order in which children encounter parts of the curriculum.

Eg1 The children may encounter decimal places or negative numbers earlier as a result of using computers.

Eg2 The children may learn how to draw a pie chart by hand later as a result of using the computer.

Eg3 The children may learn how to interpret a bar chart before they learn how to draw one (when in the past they learn how to draw one first).

11. **Indicate which of these descriptors best describes the impact of computers on progression through the curriculum in your classroom.**
(Circle all descriptors that apply)

No impact   Alters speed   Alters order

Teacher's questionnaire A v3 Page 6

Distribution of class time

This looks at how class time is scheduled or timetabled for computer related activities.

Subject timetable - Computing activities have identified time slots with pre-defined start and end times.

Core/other timetable - Some computing activities have identified time slots with pre-defined start and end times whilst at other times computing activities are subsumed or integrated with other subjects.

Integrated - Computing activities are subsumed or integrated with other activities and do not have separately identified time slots.

12. **Indicate which of these descriptors best describes the way in which computer activities are scheduled/timetabled in your classroom.**
(Circle ONE descriptor only)

Subject timetable   Core/other timetable   Integrated

Flexibility of class time

This looks at how flexible the use of time is for computer related activities (irrespective of distribution of time).

Rigid - Start and end times are clearly identified and are adhered to. Children move onto the next activity/subject when the end time is reached even if they have not finished their computer activity. They may finish off their computer activity when they have finished other timetabled work, in playtimes, in specific 'finishing off slots' or as homework.

Flexible - Start and end times are clearly identified but may be varied if a computer activity is not finished - ie the children may omit or delay the start of another activity in order to finish the current computer activity.

Fluid - There are no specified start and end times though targets may be set - the 'same' computer activity will take different lengths of time for different children.

13. **Indicate which of these descriptors best describes how flexible the timing of computer activities are in your classroom.**
(Circle ONE descriptor only)

Rigid   Flexible   Fluid

Case study 5 TH

Planning

This section deals with how much time you spend on planning for computer related activities.

Planning is used here to include time thinking about the activity, relating it to learning outcomes, etc. Planning excludes time spent on collecting together resources and actually setting up or delivering the activity once it has been planned (see below).

14. Please indicate the amount of time you spend on planning for computer related activities, specifying the units of time you are using (eg mins per day/mins per term/etc).

Range Minimum ______________

Maximum ______________

Average ______________

15. How would you describe the way in which your planning for computer related activities is distributed? (Circle ONE descriptor)

Evenly spread / intensive blocks / regular timetabled sessions / sporadic / none

16. How would you rate the quantity of time you spend on planning computer related activities on the scale below (Circle ONE descriptor).

None Some Quite a lot Lots

Preparation

This section deals with much time you spend on preparing for computer related activities.

Preparation is used here to include time spent on collecting together resources and actually setting up the activity once it has been planned (see above) and before it has been implemented. Preparation does not include time spent supporting the activity once it has started (See supporting below).

17. Please indicate the amount of time you spend on preparing for computer related activities, specifying the units of time you are using (eg mins per day/mins per term/etc).

Range Minimum ______________

Maximum ______________

Average ______________

18. How would you describe the way in which your preparation for computer related activities is distributed? (Circle ONE descriptor)

Evenly spread / intensive blocks / regular timetabled sessions / sporadic / none

19. How would you rate the quantity of time you spend on preparation for computer related activities on the scale below (Circle ONE descriptor).

None Some Quite a lot Lots

Teacher's questionnaire A v3 Page 8

Supporting

This section deals with how much time you spend supporting computer related activities in your class.

Supporting is used here to include time spent actually working with or helping children who are engaged in computer related activities in your class. It does not include time spent on preparation or planning (as identified above).

Eg1 Helping a child from your class to load some software on a computer in the shared area would be included in supporting computer use in your class.

Eg2 Introducing a computer activity and explaining what the children had to do or how to do it would be included in 'supporting'.

Eg3. Talking to a child about a printout of some work they have done on the computer would be included in 'supporting'.

20. Please indicate the amount of time you spend on supporting computer related activities in your class, specifying the units of time you are using (eg mins per day/mins per term/etc).

Range Minimum ______________

Maximum ______________

Average ______________

21. How would you describe the way in which your support for computer related activities in your class is distributed? (Circle ONE descriptor)

Evenly spread / intensive blocks / regular timetabled sessions / sporadic / none

22. How would you rate the quantity of time you spend on supporting computer related activities in your class on the scale below (Circle ONE descriptor).

None Some Quite a lot Lots

Time spent on recording pupil's progress

This section deals with how much time you spend recording pupil's progress on computer related activities.

Recording pupil's progress is used here to include all aspects of keeping records about the children's computer related activities (except filling in the computer logs associated with this research project unless you intend to keep copies of these as part of your own classroom records). Recording excludes time spent on planning, preparation and support.

23. Please indicate the amount of time you spend on recording computer related activities in your class, specifying the units of time you are using (eg mins per day/mins per term/etc).

Range Minimum ______________

Maximum ______________

Average ______________

24. How would you describe the way in which your recording of computer related activities in your class is distributed? (Circle ONE descriptor)

Evenly spread / intensive blocks / regular timetabled sessions / sporadic / none

25. How would you rate the quantity of time you spend on recording computer related activities in your class on the scale below (Circle ONE descriptor).

None Some Quite a lot Lots

Case study 5 TH

Use of other adults' time

This section looks at the amount of planning, preparation and support other adults provide for computer related activities in your class during the children's normal school day (ie between 8.45am and 3.15pm).

Other adults' time is looking at how much additional adult time is devoted to computer related activities. ie time when there is a teacher (who may or may not be the class teacher) AND one or more other adults (who may be teachers, NTAs, parents, etc) at least one of whom is working on a computer related activity in your class.

Eg1 A parent helper is supporting children from your class who are working on a computer related activity would be included.

Eg2 Some children from your class who are in a maths group that is taught by another adult (ie they are not in your maths group) would be excluded.

26. Please indicate the amount of additional adult time is spent on computer related activities in your class, specifying the units of time you are using (eg mins per day/mins per term/etc).

Range Minimum ______________

Maximum ______________

Average ______________

27. How would you describe the way in which additional adult time on computer related activities in your class is distributed? (Circle ONE descriptor)

Evenly spread / intensive blocks / regular timetabled sessions / sporadic / none

28. How would you rate the quantity of additional adult time spent on computer related activities in your class on the scale below (Circle ONE descriptor).

None Some Quite a lot Lots

Teacher's questionnaire A v3 Page 11

Quantity of space

This section looks at how much space is allocated to computers within your class.

Class is taken to include shared areas etc.

29. Rate the amount of space allocated to computers within your class on this scale (Circle ONE descriptor).

None	Some	Quite a lot	Lots

Quality of space

This section explores the quality of the space that the computers are used in? In other words how pleasant it is to work in.

30. Rate the quality of the space allocated to computers within your class on this scale (Circle ONE descriptor).

Very high	high	low	Very low

Arrangement of children

This section is trying to find out the relative occurrence of different sizes of groupings within your class. There are four possible groupings:

Individual - one child on his/her own.

Pairs - two children together.

Groups - more than two children together but less than the whole class.

Class - all the children together.

"A group exists when two or more people define themselves as members of it and when its existence is recognised by at least one other" person such as the teacher (Brown 1988 p2-3).

A pair and the class are special instances of groups.

31. Indicate the extent to which each size of grouping occurs during computer related activities in your class. (ie In each row circle ONE descriptor which says how much that grouping applies)

Individual	Never	Occasionally	Usually	Always
Pair	Never	Occasionally	Usually	Always
Group	Never	Occasionally	Usually	Always
Class	Never	Occasionally	Usually	Always

Basis for groups

This section is looking at how the composition of groups is decided upon or what criteria are used for deciding the composition of groups.

The criteria that could be used include:

age
competence (which can be interpreted hear as 'ability')
friendship
interest
gender
culture
other (this is a catchall to include any other criteria that have not been explicitly listed above)

32. Indicate the extent to which each criteria for deciding on groupings is used for groups working on computer related activities in your class. (ie In each row circle ONE descriptor which says how much that criteria applies)

Age	Never	Occasionally	Usually	Always
Competence	Never	Occasionally	Usually	Always
Friendship	Never	Occasionally	Usually	Always
Interest	Never	Occasionally	Usually	Always
Gender	Never	Occasionally	Usually	Always
Culture	Never	Occasionally	Usually	Always
Other - Specify	Never	Occasionally	Usually	Always

Ways of working

This section explores the ways in which children work when they are in groups for computer related activities. This section is not concerned with the size of groups, only with the ways in which children within a group are expected to work.

There are four ways of working:

Individual - each child has a separate task. The intended outcomes for the children are thus different with each child completing a different assignment.
Eg1 Writing stories on themes chosen by the children.

Parallel - each child has the same task but completes it independently of the other children (or is meant to complete it independently).
Eg1 The children are writing an ending to the same story, the beginning of which has been told to them by the class teacher.
Eg2 The children are completing the same worksheet and each child (in the group) has a worksheet which they have to complete.

Co-operative - the pupils are all working towards a joint outcome but each child has a different task to perform within it.
Eg1 Creating a display with one child doing the heading label and others each writing or drawing something different to include on the display.
Eg2 The group has one set of questions to answer (ie they will provide the answers as a group) and each child finds the answer to one of the questions (ie they divide the questions between them).

Collaborative - Each child is working on the same task and there will be one joint outcome.
Eg1 Solving a problem together such as discussing a moral issue.
Eg2 The group has one set of questions to answer (ie they will provide the answers as a group) and all the children work together to find the answer to each question (ie they do not divide the questions between them).

33. Indicate the extent to which each way of working occurs during computer related activities in your class. (ie In each row circle ONE descriptor which says how much that way of working applies)

Individual	Never	Occasionally	Usually	Always
Parallel	Never	Occasionally	Usually	Always
Co-operative	Never	Occasionally	Usually	Always
Collaborative	Never	Occasionally	Usually	Always

Case study 5 TH

Audience

This section deals with the audiences that the children target their work towards when working on computer related activities.

The key to this is who is the intended audience. The possible audiences are:

Private - this covers work which it is not intended for anyone except the child creating it to see (not even the teacher).
Eg The children keep private diaries which they know the teacher is not going to look at or mark (without the child's permission).

Teacher - this covers work that is not intended to be shared with anyone other than the teacher (this includes work which will be marked by the teacher even if she was not identified as being the intended audience).
Eg A child may complete a maths worksheet which is marked by the teacher but which the child's parents happen to see on a parents' evening - the intended audience was the teacher.

Class -this covers work that is going to be shared with one or more other children within the classroom and well as or instead of with the teacher.
Eg Groups of children are working on a Science activity in the knowledge that they are going to compare the results obtained by each group in a whole class session.
Eg A child produces some work which she knows in advance is going to be displayed in her classroom.

School - this covers work that is going to be shared with members of the school other than or as well as children in their own class and/or their teacher.
Eg A child creates work for a year group assembly - intended audience is the school.
Eg A child creates some work which they know in advance is going to form part of a display in the entrance lobby to the school.

Wider community - this covers work that is going to be shared with people who are not members of the school community as well as those who are.
Eg A child creates a Mother's Day card to take home to her mum.
Eg Children work on a performance which they know in advance will be seen by parents.

34. Indicate the extent to which each audience occurs during computer related activities in your class. (ie In each row circle ONE descriptor which says how much that audience applies)

Private	Never	Occasionally	Usually	Always
Teacher	Never	Occasionally	Usually	Always
Class	Never	Occasionally	Usually	Always
School	Never	Occasionally	Usually	Always
Wider	Never	Occasionally	Usually	Always

Teacher's questionnaire A v3 Page 16

Case study 5 TH

Control

This section explores the extent to which the teacher and/or children have control over aspects of the work the children do. This includes such things as who decides the what, when, where and/or how of children's work.

Four categories of control have been identified:

Teacher - The teacher is in control of the what / when / where / how of the children's work. There is no room for negotiation.

Eg1 The teacher tells the child to use GraphPlot to generate a bar chart for a set of data.

Eg2 A child asks for clarification of what she is meant to be doing and the teacher tells her.

Eg3 A child decides to do something other than what they have been told by the teacher. If the teacher becomes aware of what the child is doing she is disapproving.

Teacher initiated - The teacher initiates discussion surrounding the what / when / where / how of children's work (ie there is room for some negotiation but this is initiated by the teacher).

Eg1 The teacher tells the child to analyse some data using the computer and asks the child to decide which program or method of analysis to use.

Eg2 A child asks the teacher for clarification of what she is meant to be doing and the teacher initiates a discussion about what the child thinks it would be most appropriate for her to do next.

Child initiated - The child initiates discussion surrounding the what / when / where / how of their work (ie there is room for some negotiation but this is initiated by the child).

Eg1 The teacher tells the child to write a story in her draft book. The child asks if she can do it on the computer instead.

Child - The child is in control of the what / when / where / how of her work. She may discuss it with the teacher but the child makes the final decisions.

Eg1 The child is working on the computer (possibly at the direction of the teacher) and decides to explore some new feature of the software. The teacher is not consulted but would generally be happy for children to take control in this manner.

35. Indicate the extent to which each control category occurs during computer related activities in your class. (ie In each row circle ONE descriptor which says how much that category applies)

Teacher	Never	Occasionally	Usually	Always
Teacher initiated	Never	Occasionally	Usually	Always
Child initiated	Never	Occasionally	Usually	Always
Child	Never	Occasionally	Usually	Always

Teacher's questionnaire A v3 Page 17

Case study 5 TH

Sources of expertise

This section looks at the human sources of expertise in computer related activities within the class. The emphasis here is on the sources of expertise the teacher expects and/or directs the children to use.

There are four categories of human expertise which a teacher may make use of:

Teacher - The teacher intends the children to use the teacher (ie herself) as a source of expertise.

Other staff - The teacher intends the children to use other staff as a source of expertise.

Other adults - The teacher intends the children to use other adults (ie who are not paid to work in the school) as a source of expertise.

Children - The teacher intends the children to use other children as a source of expertise.

36. Indicate the extent to which each of the sources of expertise apply during computer related activities in your class. (ie In each row circle ONE descriptor which says how much that source applies)

Teacher	Never	Occasionally	Usually	Always
Other staff	Never	Occasionally	Usually	Always
Other adults	Never	Occasionally	Usually	Always
Children	Never	Occasionally	Usually	Always

Teacher's questionnaire A v3 Page 18

Teacher fallibility

This section explores the view of teacher fallibility within the classroom that the teacher tries to maintain when dealing with computer related activities. The emphasis here is again on the perception that the teacher intends the children to have (even where this is different from the view that they actually hold).

There are three categories:

Infallible teacher - the teacher intends herself to be viewed as infallible. She is the expert and does not admit to the children to having uncertainty or weakness in terms of her knowledge, skills or understanding.

Teacher as expert - the teacher intends herself to be viewed as knowledgeable about the subject but does not claim to know or understand everything about it. She would acknowledge that other (greater) sources of expertise exist and that she is not always correct/right/infallible.

Teacher as learner - the teacher intends herself to be viewed as learning alongside the children. Whilst she may be more knowledgeable than they are she readily reveals to the children her uncertainties or weaknesses in terms of knowledge, skills or understanding. The teacher does not intend herself to be viewed as 'the expert' (even where she does actually have significant expertise).

37. Indicate which of these descriptors best describes the view of teacher fallibility which she tries to maintain when dealing with computer related activities.
(Circle ONE descriptor only)

Infallible teacher   Teacher as expert   Teacher as learner

Case study 5 TH

Teachers Questions

This section explores the nature of the questions that the teacher asks her children in the context of computer activities. The focus of the section is on the extent to which the children's responses to the questions the teacher asks are viewed as being 'right' or 'wrong'.

Two types of question are identified:

Open questions - The teacher is trying to elicit from the children what they think. There are no right or wrong answers. The children's responses may be inappropriate (ie the do not answer the question that was asked) but they cannot be incorrect.

Eg. What do you think is going to happen? The teacher accepts any response the children provide even if it is technically or factually incorrect so long as it answers the question she asked - ie it is what the child thinks will happen.

Closed questions - The teacher asks a question to which a range of 'correct' answers are possible. The answers are correct in as much as the teacher is willing to accept them.

Eg1 What sort of pet does anyone in the class have? (A range of possible answers may be given, some of which are not anticipated by the teacher, but which she accepts non-the-less)
Eg2 Why did the light bulb light up? (The teacher only accepts a limited range of answers as being correct)

38. Indicate the extent to which each type of question is used by the teacher during computer related activities in your class. (ie In each row circle ONE descriptor which says how much that type of question applies)

Open	Never	Occasionally	Usually	Always
Closed	Never	Occasionally	Usually	Always

39. Indicate what you would consider to be reasonable interpretations of the words 'Never', 'Occasionally', 'Usually' and 'Always' in this context?

Eg1 'Always' might range from 90% of the time to 100% of the time

	Minimum % of time	Maximum % of time
Never		
Occasionally		
Usually		
Always		

Teacher's questionnaire A v3 Page 20

Responses to the Teachers' Questionnaires

Questions No	Description	Case Study 4 Mrs Light		Case Study 5 Mrs Henry	
1	Quantity of computer in use per day				
	Range - min	0		0	
	Range - max	180		240	
	Average	60		120	
2	Sum of time spent on computers				
	Range - min	45		0	
	Range - max	210		180	
	Average	90		60	
3	Distribution of computer use	intensive blocks		regular timetabled sessions	
		except SEN who are timetabled			
4	Quantity rating	Some	20-90 mins per day	some	15.5
5	Quantity vaules				
	None min	0		0	0
	None max	0		0	
	Some min	20		1	15.5
	Some max	90		30	
	Quite a lot min	91		31	45.5
	Quite a lot max	180		60	
	Lots min	180		60	180
	Lots max	300		300	
6	Focus				
	Pragmatic	some	20.5	some	38
	Computing	quite a lot	50.5	some	38
	Learning	some	20.5	some	38
7	Focus values				
	None min	0	5	0	
	None max	10		25	
	Some min	11	20.5	26	38
	Some max	30		50	
	Quite a lot min	31	50.5	51	
	Quite a lot max	70		75	
	Lots min	71	85.5	76	
	Lots max	100		100	
8	Mode				
	Repetition	quite a lot	50.5	some	38
	Replacement	none	5	none	12.5
	Extension	some	20.5	some	38
9	Mode values				
	None min	0	5	0	
	None max	10		25	
	Some min	11	20.5	26	
	Some max	30		50	
	Quite a lot min	31	50.5	51	
	Quite a lot max	70		75	
	Lots min	71	85.5	76	
	Lots max	100		100	

Questions			**Case Study 4**		**Case Study 5**	
No	**Description**		**Mrs Light**		**Mrs Henry**	
10	Curriculum content		plus IT		plus IT	
11	Progression		no impact		no impact/alters speed	
12	Distrubution of class time		integrated		core/other	
13	Flexibility of class time		fluid		flexible	
14	Planning					
		Range - min	20 mins per week		10 hours per term	
		Range - max	60 mins per week		16 hours per term	
		Average	30 mins per week		12 hours per term	
15		Distribution	intensive blocks		regular timetabled sessions	
16		Quantity	some		some	
17	Preparation					
		Range - min	10 mins per day		30 mins per week	
		Range - max	20 mins per day		60 mins per week	
		Average	15 mins per day		30 mins per week	
18		Distribution	intensive blocks		regular timetabled sessions	
19		Quantity	some		some	
20	Supporting					
		Range - min	10 mins per day		10 mins per day	
		Range - max	30 mins per day		60 mins per day	
		Average	20 mins per day		20 mins per day	
21		Distribution	intensive blocks		regular timetabled sessions	
22		Quantity	some		some	
23	Recording					
		Range - min	30 mins per term		0 mins per day	
		Range - max	60 mins per term		10 mins per day	
		Average	40 mins per term		5 mins per day	
24		Distribution	intensive blocks		sporadic	
25		Quantity	some		some	
26	Other adults					
		Range - min	5 mins per day		0	
		Range - max	30 mins per day		0	
		Average	20 mins per day		0	
27		Distribution	sporadic		none	
28		Quantity	some		none	
29	Quantity of space		some		some	
30	Quality of space		low		high	
31	Arrangement of children					
		Individual	occasionally	25.5	occasionally	38
		Pair	usually	55.5	usually	63
		Group	occasionally	25.5	occasionally	38
		Class	occasionally	25.5	usually	63
32	Basis for groups					
		Age	usually	55.5	never	12.5
		Competence	occasionally	25.5	usually	63
		Friendship	occasionally	25.5	occasionally	38
		Interest	occasionally	25.5	occasionally	38
		Gender	occasionally	25.5	occasionally	38
		Culture	occasionally	25.5	never	12.5
		Other	usually	55.5		
			work on similar skills			
			alphabetical list			
			who is free			

Questions		**Case Study 4**		**Case Study 5**	
No	**Description**	**Mrs Light**		**Mrs Henry**	
33	Ways of working				
	Individual	occasionally	25.5	occasionally	38
	Parallel	occasionally	25.5	occasionally	38
	Co-operative	occasionally	25.5	occasionally	38
	Collaborative	occasionally	25.5	occasionally	38
34	Audience				
	Private	never	5	never	12.5
	Teacher	usually	55.5	occasionally	38
	Class	occasionally	25.5	occasionally	38
	School	occasionally	25.5	occasionally	38
	Wider	occasionally	25.5	occasionally	38
35	Control				
	Teacher	usually	55.5	occasionally	38
	Teacher initiated	occasionally	25.5	occasionally	38
	Child initiated	occasionally	25.5	occasionally	38
	Child	occasionally	25.5	occasionally	38
36	Sources of expertise				
	Teacher	usually	55.5	usually	63
	Other staff	occasionally	25.5	occasionally	38
	Other adults	never	5	never	12.5
	Children	occasionally	25.5	occasionally	38
37	Teacher fallability	learner		learner	
38	Teacher's questions				
	Open	occasionally	25.5	occasionally	38
	Closed	usually	55.5	usually	63
39	Interpretation of terms				
	Never - min	0	5	0	12.5
	Never - max	10		25	
	Occasionaly min	11	25.5	26	38
	Occasionaly max	40		50	
	Usually min	41	55.5	51	63
	Usually max	70		75	
	Always min	71	85.5	76	88
	Always max	100		100	

Appendix E
Case Studies 4 to 6 – Initial Questionnaire

Questionnaire 1
Computer Measures Research

Please complete and return this entire questionnaire if you **still wish to take part in this research project**. You should have read the document headed 'Computer Measures Research - Information Sheet' and discussed it with relevant colleagues BEFORE you fill in this questionnaire.

What will the information provided on this questionnaire be used for?
The information you provide on this questionnaire will be used exclusively for legitimate research purposes. The main function of the questionnaire is to help in the selection of the schools which will take part in this research project. In the event that any of this information needs to be included within any subsequent research publications all names will be altered.

Instructions for filling in the questionnaire
When filling in the questionnaire please do so as rapidly as possible - off the cuff responses are what are wanted! For example, in the section that asks about your computer resources I do NOT want you to spend time doing a full and accurate inventory; what I am after is an indication of the sorts of quantities and types of equipment that your school has.

School Details
(Please correct any errors in this section)

School name: Brookdale Combined School

Address: Somewhere in England!
Details hidden.

Phone:
Fax:
Email:

Head Teacher Mr Pratchet

Main contact Mrs Henry
Main contact's role IT co-ordinator

Name of person who filled in the Questionnaire Mrs Henry

Position of person who filled in the Questionnaire IT co-ordinator

Please return to:
Peter Twining, School of Education, The Open University,
Walton Hall, Milton Keynes MK7 6AA.

Questionnaire 1 Computer Measures Research

Please indicate how many of each type of computer your school has

BBC/Master	Archimedes (eg A3000 etc)	RiscPC	RM 380/480/Nimbus (PC186)	PC286/386	PC486/Pentium etc	Apple Mac	Acorn Notebook	Acorn Pocketbook	PC Notebook	Apple Notebook	Other (please specify)
6	12	1			2			21			

Please indicate how many of each of the following your school has

Dot matrix printers	Inkjet (Black) printers	Inkjet (Colour) printers	Laser Printers	Modems	Internal hard disc drives	External hard disc drives	Internal CD ROM drives	External CD ROM drives	Touch Screens	Overlay keyboards (Eg Concept keybrd)	Scanners	Digital Cameras	Control/buffer boxes	Other (please specify)
12		1	2		11		2			3	1			

Questionnaire 1

Computer Measures Research

How many of each of the following does your school have?

Fax machines	0
Telephones	3
Telephone lines	1
Computers connected to the Internet	0
Computers connected to a local network	0
Televisions	3
Other IT equipment (please specify)	

How many computers would you expect to find in each of these locations?

In each classroom	1
In shared areas	
In the library	1
In a computer room	
In the staff room	
Wherever they are needed	1
In the secretaries office	2
In the Head's office	1
Other (please specify)	

Soon adding a CD Rom here
CD Roms shared around school

Questionnaire 1

Computer Measures Research

Approximately how much money was spent on each of these things in 96-97

Computer hardware for educational use	£500.00
Computer software for educational use	500.00
Computer hardware for admin use	
Computer software for admin use	
INSET for teaching staff	~~400.00~~
INSET for admin staff	
Other IT expenditure (please specify)	

PTO

Questionnaire 1

Computer Measures Research

How many pupils are there in your school? **500**

How many classess does your school have? **16**

How many teachers are there? **17**

How many other teaching support staff are there? (eg Nursery nurses, ancillaries, etc) **8**

Indicate the answer to which each of the following questions (For each statement tick one box only)

	Lots	Quite a lot	Some	Not much/many	None
To what extent do parents (and/or other adults) come into school to work with the children?			✓		
How much turnover of staff does the school have?			✓		
To what extent is the school used outside normal school hours?			✓		
How much space is there in the school relative to the number of children?			✓		
How much confidence do the staff in your school have in their ability to manage their classes?		✓			
How much teaching experience would you describe your school's staff as having?		✓			
How many children in the school are entitled to free school meals?				✓	

Identify the degree to which each of the following statements applies to your school (For each statement tick one box only)

	Never	Seldom	Sometimes	Often	Always	
The children are in mixed age classes						?
There are more than 30 children in each class				✓		
Teacher's plan collaboratively				✓		
Teacher's teach collaboratively			✓			
Parents who help in the classes are welcome in the staffroom				✓		

Questionnaire 1 Computer Measures Research

For each statement below please indicate if it is true or false by placing a tick in one column

	TRUE	FALSE	
The school is open plan	✓		
The school has a lot of 'out of catchment' children	✓		
The school has had an OFSTED inspection		✓	Feb.98

	Yes	No	Don't know
Has the school been involved in any research projects before?		✓	
Have you discussed this research with the staff who might be involved in it?	✓		
Are there at least two Y3, Y4, Y5 or Y6 class teachers in your school who would like to take part in this research?	✓		

Below is a list of ways in which the researcher might be able to help the school enhance the ways which it currently uses computers. Please rank them to indicate which you think would be most useful for your school. (1 = most useful)

Provide additional computing equipment	1 ✓
Provide technical support	4 ✓
Provide external consultancy focussing on the development of the school's IT strategy	3
Provide classroom support for the research classes	6
Provide one days INSET on computers for the whole school	7
Provide a series of short INSET sessions for the whole school on computers	2
Provide individualised INSET for the staff in the research classes	
Provide staff with informal support for computer use	8
Provide 'training' for children in how to use computers	5
Other (please specify)	

Why does the school wish to be involved in this project?

To help us further develop our use of IT in the classroom.

Questionnaire 1 Computer Measures Research

For each question put a tick in one column to indicate your response	Lots	Quite a lot	Some	Not much	None
On average how much use would you estimate is made of the computers in your school?			✓		
To what extent do the educational support staff (eg nursery assistants, etc) use computers?			✓		
How much technical support is available to staff to help them deal with computer related problems?			✓		
What contribution do computers make to teaching in your school?			✓		
What contribution do computers make to learning in your school?			✓		
What contribution do computers make to administration in your school?		✓			
To what extent are children seen as being more competent computer users than the staff in your school?			✓		
teaching eachother how to use computers?		✓			
How much use is made of wordprocessing software by the children?		✓			
How much use is made of drill and skill software (eg spelling programs) by the children?			✓		
How much use is made of adventure games and simulations by the children?			✓		
How much use is made of data handling software (including spreadsheets) by the children?			✓		
How much use is made of Logo and/or control (inc Pips or Roamers) by the children?		✓			
How much use is made of Integrated Learning Systems (ILS) by the children?					✓
How much use is made of multimedia by the children?				✓	
How much use is made of painting or drawing software by the children?			✓		
To what extent are computers used to access information by the children			✓		
To what extent are computers used as a means of communication (eg email, computer conferencing) by the children					✓

Questionnaire 1 Computer Measures Research

If computers are used by the children in other ways please list them and indicate the extent of use	Lots	Quite a lot	Some	Not much	None

For each question put a tick in one column to indicate your response	Lots	Quite a lot	Some	Not many	None
How many staff in your school have had little or no IT focused INSET					✓
How many staff in your school have had more than one day of IT focused INSET?		✓			
How many staff in your school have had extensive IT focused INSET?				✓	
How many staff in your school have successfully completed a certificated course which focussed on educational computer use?					✓
How many of the staff in this school are confident computer users				✓	
How many of the staff in this school are competent computer users?			✓		
How many of the staff in this school are confident in their ability to use manage and organise their children's use of computers?				✓	
How many children in your school use a computer at least once per week?			✓		
How many of the staff in your school make regular use of computers with their children?			✓		

For each question please put a tick in one column to Indicate your answer	Yes	No
Does the school have an identified IT co-ordinator?	✓	
Does the school have an IT policy document?	✓	
Has IT been identified as a priority area in the schools latest development plan?	✓	

If yes, how many hours of non contact time does she get to fulfill her role?

negotiate when necessary otherwise own time.

Questionnaire 1 Computer Measures Research

Please indicate the extent to which each of the following statements is true for your school.

	Entirely	Mostly	To some extent	Not really	Not at all
The reason why teachers in this school use computers is to help the children learn in other subject areas		✓			
The reason why teachers in this school use computers is because they feel they ought to use them			✓		
The reason why teachers in this school use computers is to help the children learn about computers (IT)		✓			
The reason why teachers in this school use computers is because they are required to by the NC			✓		
The staff use computers to help them prepare their teaching			✓		
The children use computers to do things which they could not do in any other way				✓	
The children use computers to do things which they have already learnt to do without a computer		✓			

If you feel there is any information about your school which you think might be relevant to this research project please note it below.

Questionnaire 1 Computer Measures Research

Appendix F
Case Studies 4 – Analysis of each activity against the Computer Practice Framework

Analysis of each activity against the Computer Practice Framework

7th Jan	Two children using Crystal Rainforest		
Quantity	240 minutes (240/300)		
	%	80%		
Focus	Manual Log **-** Using Crystal Rainforest in order to have "Experience of using a game programme". Observation of other children in the class using Crystal Rainforest at other times indicated that they were: developing a range of problem solving skills; engaging in discussion and decision making; applying mathematical knowledge; etc.. It seems probable that the same was true for these two children.		
	Category	**Pragmatic**	**Computing**	**Learning**
	%	20	10	70
Mode	This is an adventure game set in the rainforest, in which the user has to locate a missing person. The software presents the users with a number of problems, mainly of a mathematical/logical nature. These are contextualised to varying degrees within the software. The users also have to navigate through the rainforest as they search for the missing person. This is an activity that could not easily be done without a computer and as such falls within the category of extension. However, many of the problems presented within the software could be presented without the aid of a computer and constitute repetition. It seems likely that these two children would have been working collaboratively, as was the case for all the instances of this software being used that the researcher witnessed. Despite children's claims that they rarely worked together in English (Informal interview 21.1.98) there is substantial evidence to show that they were working collaboratively throughout most of their topic work on the Rainforest (e.g. Weekly Plans, Non-participant observations, Interview with teacher). Thus the use of this software does not appear to have extended the practice in this area.		
	Category	**Repetition**	**Replacement**	**Extension**
	%	70	0	30

7th Jan	**Using Pocketbooks to write up best copy of part of a story**			
Quantity	105 minutes (105/300)			
	%	35%		
Focus	**Manual Log -** The majority of the class used the pocket books "To write part of a story in best". **Observation** of other sessions in which the children used the pocket books (as described previously) suggests that they were simply copy typing. The focus on producing a best copy might suggest that one of the reasons for using the computer might have been presentational. **Plans** - The medium plans for the previous term contain very few references to IT (two mentions under geography) and no mention of the pocket books. This might suggest that the class teacher had increased her level of IT use in response to the knowledge that a researcher who had an interest in computer use was coming in. **Informal interview** (30.1.98) - Teacher E said that she had agreed to take part in the research because the IT was not built into her planning, it was added on/separate.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%	30	70	0
Mode	**Manual Log** and **non-participant observation** of other sessions in which the children used the pocket books both suggest that the activity here was copy typing. Observation of the children on subsequent occasions using the pocket books and discussion with them indicated that they had used them before in much the same way. This activity thus constitutes Repetition. There was no evidence of the children drafting on the pocket books, which might have moved it from repetition to extension.			
	Category	**Repetition**	**Replacement**	**Extension**
	%	100%		

9th Jan	**Two children using Crystal Rainforest**			
Quantity	120 minutes (120/300)			
	%	40%		
Focus	**Manual Log -** "To experience using Crystal Rainforest". **Observation** of other children in the class using Crystal Rainforest at other times indicated that they were: developing a range of problem solving skills; engaging in discussion and decision making; applying mathematical knowledge; etc.. It seems probable that the same was true for these two children.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%	20	10	70
Mode	As for use of Crystal Rainforest on 7th Jan			
	Category	**Repetition**	**Replacement**	**Extension**
	%	70	0	30

12th Jan	**Two children using Crystal Rainforest**			
Quantity	90 minutes (90/300)			
	%	30%		
Focus	**Observation** of other children in the class using Crystal Rainforest at other times indicated that they were: developing a range of problem solving skills; engaging in discussion and decision making; applying mathematical knowledge; etc.. It seems probable that the same was true for these two children.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%	20	10	70
Mode	As for use of Crystal Rainforest on 7th Jan			
	Category	**Repetition**	**Replacement**	**Extension**
	%	70	0	30

<table>
<tr><td>13th Jan</td><td colspan="4">Two children using Pendown to produce a questionnaire.</td></tr>
<tr><td rowspan="2">Quantity</td><td colspan="4">90 minutes (90/300)</td></tr>
<tr><td>%</td><td colspan="3">30%</td></tr>
<tr><td rowspan="3">Focus</td><td colspan="4">Manual Log - Two girls used Pendown "To produce a questionnaire" related to the Rainforest Café [class topic].
This suggests that they were using the computer as a tool to help them carry out some data collection. Pendown is a program that there is evidence that the children have used in other contexts, particularly in relation to their use of the pocket books. The fact that they used Pendown rather than an unfamiliar program such as Junior Pinpoint (despite the fact that Junior Pinpoint was mentioned in the teacher's medium term plans) might indicate that the focus was on doing the questionnaire rather than learning to use a new computer program.
As before it seems reasonable to conclude that there were a number of other reasons for using the computer for this task, including this research, but also the desire to produce a 'high quality' questionnaire for use with other children in the school.</td></tr>
<tr><td>Category</td><td>Pragmatic</td><td>Computing</td><td>Learning</td></tr>
<tr><td>%</td><td>30</td><td>10</td><td>60</td></tr>
<tr><td rowspan="3">Mode</td><td colspan="4">The Manual Log indicates that this activity involved two children using Pendown to create a questionnaire. It seems probable that these two children had both used Pendown and created questionnaires before, given the other similar acitivites taking place in the classroom at the time. Thus this activity constitues repetition. There is no evidence to suggest that the use of Pendown extended what the children were able to do in terms of designing the questionnaire, beyond improving the presentation of it.</td></tr>
<tr><td>Category</td><td>Repetition</td><td>Replacement</td><td>Extension</td></tr>
<tr><td>%</td><td>100</td><td>0</td><td>0</td></tr>
</table>

<table>
<tr><td>19th Jan</td><td colspan="4">Three children using Graphplot to graph data from questionnaire</td></tr>
<tr><td rowspan="2">Quantity</td><td colspan="4">105 minutes (105/300)</td></tr>
<tr><td>%</td><td colspan="3">35%</td></tr>
<tr><td rowspan="3">Focus</td><td colspan="4">Manual Log - Three girls using Graph Plot "To put data onto a graph". This data was from the Rainforest Café questionnaire (see 13.1.98). This seems to suggest that the focus was to use the computer as a tool to generate graphs. The fact that the children used Graph Plot, which is a very simple program, suggests that they would not have to have spent much time learning to use the software even if they were not already familiar with it. The non-participant observation of the girls using the computer in the early afternoon suggested that they were confident using the software. There is no evidence to indicate whether the computer was being used on this occasion to allow the children to analyse the data more easily or for purely presentational reasons.</td></tr>
<tr><td>Category</td><td>Pragmatic</td><td>Computing</td><td>Learning</td></tr>
<tr><td>%</td><td>30</td><td>10</td><td>60</td></tr>
<tr><td rowspan="3">Mode</td><td colspan="4">The Manual Log indicates that this activity involved three girls using Graph Plot to generate a graph based on the data from the Rainforest Café questionnaire. There is little evidence to suggest the extent to which the activity extended their thinking about the data. They appear to have only carried out one form of analysis and thus the use of the software does not appear to have extended their mathematical thinking. These children will already have been familiar with drawing graphs of this kind and they would have been capable of doing so for this data. Thus the software does not appear to have extended their learning.</td></tr>
<tr><td>Category</td><td>Repetition</td><td>Replacement</td><td>Extension</td></tr>
<tr><td>%</td><td>100</td><td>0</td><td>0</td></tr>
</table>

<table>
<tr><td>19th Jan</td><td colspan="4">Two boys using Crystal Rainforest</td></tr>
<tr><td rowspan="2">Quantity</td><td colspan="4">Non-participant observation - 1.17 to 2.52</td></tr>
<tr><td>%</td><td colspan="3">32%</td></tr>
<tr><td rowspan="3">Focus</td><td colspan="4">Whilst there is no mention of this activity in the Manual Logs, the non-participant observation indicated that two boys used Crystal Rainforest, with occasional help from a third boy. There was an element of learning how to use the software, but this was fairly minimal and most of the activity focussed on trying to solve the problem (finding Gomez) and the sub-problems that were presented as obstacles to be overcome on the way. The boys were: developing a range of problem solving skills; engaging in discussion and decision making; applying mathematical knowledge; etc..</td></tr>
<tr><td>Category</td><td>Pragmatic</td><td>Computing</td><td>Learning</td></tr>
<tr><td>%</td><td>20</td><td>10</td><td>70</td></tr>
<tr><td rowspan="3">Mode</td><td colspan="4">As for use of Crystal Rainforest on 7th Jan</td></tr>
<tr><td>Category</td><td>Repetition</td><td>Replacement</td><td>Extension</td></tr>
<tr><td>%</td><td>70</td><td>0</td><td>30</td></tr>
</table>

<table>
<tr><td>20th Jan</td><td colspan="4">Use of Pendown to copytype a story</td></tr>
<tr><td rowspan="2">Quantity</td><td colspan="4">Non-participant observation - 10.56</td></tr>
<tr><td>%</td><td colspan="3">10%</td></tr>
<tr><td rowspan="3">Focus</td><td colspan="4">Whilst there is no record of any computer use in the Manual Log for today, the researcher observed that Pendown was loaded on the computer and some text had been typed into it. There was a hand written story sticking out from under the keyboard which had the same text as that on the screen. This suggests that one or more children had been copy typing the story into Pendown. There was no evidence of the work having been edited or revised within Pendown.</td></tr>
<tr><td>Category</td><td>Pragmatic</td><td>Computing</td><td>Learning</td></tr>
<tr><td>%</td><td>30</td><td>70</td><td>0</td></tr>
<tr><td rowspan="3">Mode</td><td colspan="4">The researcher observed that Pendown had been used to copy type a story. There was no evidence of the work having been edited on screen. Thus this constitutes repetition.</td></tr>
<tr><td>Category</td><td>Repetition</td><td>Replacement</td><td>Extension</td></tr>
<tr><td>%</td><td>100</td><td>0</td><td>0</td></tr>
</table>

<table>
<tr><td>21st Jan</td><td colspan="4">One child setting up connection between PocketBook and PC</td></tr>
<tr><td rowspan="2">Quantity</td><td colspan="4">25 minutes (25/300)</td></tr>
<tr><td>%</td><td colspan="3">8%</td></tr>
<tr><td rowspan="3">Focus</td><td colspan="4">Manual Log records Patrick as "setting up the pocket books on PC". Non-participant observation recorded two boys transferring files between a pocket book and the Acorn (as described above). The purpose of this activity seems to have been to enable children to print out their work and so that the boys could reinforce their IT skills (ie how to connect the pocket book to the Acorn and how to transfer files).</td></tr>
<tr><td>Category</td><td>Pragmatic</td><td>Computing</td><td>Learning</td></tr>
<tr><td>%</td><td>50</td><td>50</td><td>0</td></tr>
<tr><td rowspan="3">Mode</td><td colspan="4">On the basis of the Manual Log and non-participant observation this appears to have been a predominantly technical activity which the children had performed previously. Thus it involved reinforcement of existing skills rather than new learning.</td></tr>
<tr><td>Category</td><td>Repetition</td><td>Replacement</td><td>Extension</td></tr>
<tr><td>%</td><td>100</td><td>0</td><td>0</td></tr>
</table>

<table>
<tr><td>21st Jan</td><td colspan="4">Using pocket book to write up 'beginning middle end'</td></tr>
<tr><td rowspan="2">Quantity</td><td colspan="4">One child started at 10.10. Other children started at various intervals throughout the session.</td></tr>
<tr><td>%</td><td colspan="3">10%</td></tr>
<tr><td rowspan="3">Focus</td><td colspan="4">Manual Log records one child as "writing my beginings middles and ends up" on a pocket book. Non-participant observation noted Patrick doing his first draft straight onto a pocket book and another child copy typing her best copy, having already drafted and corrected in her draft book. Patrick had specifically asked the teacher if he could write straight onto the pocket book. On the basis of the other children's reactions to this and their comments to the researcher (which have already been reported above) this was unprecedented. No other children were allowed to write straight onto the pocket books and the researcher's impression was that Patrick was allowed to do it by the teacher as a favour to him and/or to stop him pestering her.</td></tr>
<tr><td>Category</td><td>Pragmatic</td><td>Computing</td><td>Learning</td></tr>
<tr><td>%</td><td>30</td><td>70</td><td>0</td></tr>
<tr><td rowspan="3">Mode</td><td colspan="4">On the basis of the Manual Log and non-participant observation there appear to have been two different activities taking place here. One involved a single child drafting directly onto a pocket book and the other involved copy typing. All of the children were expected to draft and re-draft whether or not they were working on paper or a pocket book. This suggests that the use of the pocket books did not extend their practice.</td></tr>
<tr><td>Category</td><td>Repetition</td><td>Replacement</td><td>Extension</td></tr>
<tr><td>%</td><td>100</td><td>0</td><td>0</td></tr>
</table>

<table>
<tr><td>21st Jan</td><td colspan="4">Four children using PocketBooks and PC to write up 'beginning middle end'</td></tr>
<tr><td rowspan="2">Quantity</td><td colspan="4">75 minutes (75/300)</td></tr>
<tr><td>%</td><td colspan="3">25%</td></tr>
<tr><td rowspan="3">Focus</td><td colspan="4">Manual Log records four children using pocket books to write up beginnings, middles and ends. Non-participant observation noted five or six pocket books being used by pairs of children (though by and large they were taking turns to use them rather than collaborating). As noted in the previous description of computer use on Wednesday morning, the children were copy typing.</td></tr>
<tr><td>Category</td><td>Pragmatic</td><td>Computing</td><td>Learning</td></tr>
<tr><td>%</td><td>30</td><td>70</td><td>0</td></tr>
<tr><td rowspan="3">Mode</td><td colspan="4">On the basis of the Manual Log and non-participant observation it appears that this activity involved pairs of children copy tying into the pocket books. There is some evidence that it was unusual for the children to work in pairs during English (Informal Interview 21.1.98). However the non-participant observation and other informal interviews indicate that the children were merely taking turns to use the same pocket book, as they were used to doing with other resources such as dictionaries that were in short supply. They were thus not working collaboratively. Thus working in pairs in this way does not constitute an extension of practice.</td></tr>
<tr><td>Category</td><td>Repetition</td><td>Replacement</td><td>Extension</td></tr>
<tr><td>%</td><td>100</td><td>0</td><td>0</td></tr>
</table>

<table>
<tr><td>21st Jan</td><td colspan="4">Four children using Pocketbooks to write up their 'beginnings'</td></tr>
<tr><td rowspan="2">Quantity</td><td colspan="4">35 minutes (35/300)</td></tr>
<tr><td>%</td><td colspan="3">12%</td></tr>
<tr><td rowspan="3">Focus</td><td colspan="4">Manual Log records four children using pocket books to write up beginnings, middles and ends. It seems reasonable to assume that the Focus was the same as for previous sessions in which children were using the pocket books.</td></tr>
<tr><td>Category</td><td>Pragmatic</td><td>Computing</td><td>Learning</td></tr>
<tr><td>%</td><td>30</td><td>70</td><td>0</td></tr>
<tr><td rowspan="3">Mode</td><td colspan="4">As for use of PocketBooks on 7th Jan</td></tr>
<tr><td>Category</td><td>Repetition</td><td>Replacement</td><td>Extension</td></tr>
<tr><td>%</td><td>100</td><td>0</td><td>0</td></tr>
</table>

Summary of the analysis of the computer use in the first half of the spring term

Date/Activity	7.1a	7.1b	9.1	12.1	13.1	19.1a	19.1b	20.1	21.1a	21.1b	21.1c	21.1d
No children	2	20	2	2	2	3	2	1	2	3	15	4
Quantity												
Length (mins)	240	105	120	90	105	105	95	30	27	29	71	35
%	80	35	40	30	35	35	32	10	9	10	24	12
Focus												
Computing	10	70	10	10	10	10	10	70	50	70	70	70
Learning	70	0	70	70	60	60	70	0	0	0	0	0
Pragmatic	20	30	20	20	30	30	20	30	50	30	30	30
Mode												
Repetition	70	100	70	70	100	100	70	100	100	100	100	100
Replacement	0	0	0	0	0	0	0	0	0	0	0	0
Extension	30	0	30	30	0	0	30	0	0	0	0	0
Weighted Focus												
Computing	1600	49000	800	600	700	1050	633	700	900	2030	24850	3267
Learning	11200	0	5600	4200	4200	6300	4433	0	0	0	0	0
Pragmatic	3200	21000	1600	1200	2100	3150	1267	300	900	870	10650	1400
Weighted Mode												
Repetition	11200	70000	5600	4200	7000	10500	4433	1000	1800	2900	35500	4667
Replacement	0	0	0	0	0	0	0	0	0	0	0	0
Extension	4800	0	2400	1800	0	0	1900	0	0	0	0	0

Summary of the weighted ratings for each day

Date	January																			
	6	7	8	9	12	13	14	15	16	19	20	21	22	23	26	27	28	29	30	Total	Mean
Quantity																					
%	0	87	0	40	30	35	0	0	0	67	10	54	0	0	0	0	0	0	0		**17**
Weighted Focus																					
Computing	0	50600	0	800	600	700	0	0	0	1683	2030	31047	0	0	0	0	0	0	0	4603	**51**
Learning	0	11200	0	5600	4200	4200	0	0	0	10733	0	0	0	0	0	0	0	0	0	1891	**21**
Pragmatic	0	24200	0	1600	1200	2100	0	0	0	4417	870	13820	0	0	0	0	0	0	0	2537	**28**
Weighted Mode																					
Repetition	0	81200	0	5600	4200	7000	0	0	0	14933	2900	44867	0	0	0	0	0	0	0	8458	**94**
Replacement	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	**0**
Extension	0	4800	0	2400	1800	0	0	0	0	1900	0	0	0	0	0	0	0	0	0	574	**6**

Appendix G
Case Studies 5 – Analysis of each activity against the Computer Practice Framework

Analysis of each activity against the Computer Practice Framework

19th Jan	**Two boys using Kidpix to create World War II poster**			
Quantity	Manual logs: 80 minutes (80/300)			
	%	27%		
Focus	The rest of the class were doing outdoor games. These two boys were unable to do games. This was an activity that they had started the previous term.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%	80	10	10
Mode	The poster could have been done using another media. There was no evidence of the computer use having changed what they were learning.			
	Category	**Repetition**	**Replacement**	**Extension**
	%	50	50	0

20th Jan	**SEN twins using typing tutor software on Acorn**			
Quantity	Manual Log: 20 minutes (20/300)			
	%	7%		
Focus	The focus was on learning how to touch type.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%		100%	
Mode	They had undertaken this same activity on previous occasions, and were repeating it in order to reach the stage where they did not have to think about how to type.			
	Category	**Repetition**	**Replacement**	**Extension**
	%	100		

20th Jan	**3 'groups' of children using Monty during Maths session**			
Quantity	Manual log: 55 minutes (55/300)			
	%	18%		
Focus	Children were familiar with how to operate the software. The activity was a regular feature of the maths work in this half term.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%			100%
Mode	The children were reinforcing their knowledge of tables and number grids.			
	Category	**Repetition**	**Replacement**	**Extension**
	%	100		

21st Jan	**Stephen and Mrs Henry writing up the 10 commandments on the Pocketbook during RE**			
Quantity	Manual Log: 15 minutes (15/300)			
	%	5%		
Focus	This was an integral part of the RE session. The other children were doing the same activity on paper. Mrs Henry scribed for Stephen. Aim appeared to be to enable Stephen to complete the activity along with the other children – the use of the Pocketbook meant that it would not be obvious from the final product who had entered the text.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%			100%
Mode	This activity could have been done without the Pocketbook, as was the case for all the other children. Mrs Henry could have scribed for Stephen on paper.Listing the 10 commandments was not something Stephen had done before.			
	Category	**Repetition**	**Replacement**	**Extension**
	%		100	

21st Jan	**Mrs Green demonstrating Graphplot to her maths group**			
Quantity	Manual Log: 30 minutes (30/300)			
	%	10%		
Focus	The aim of this session was to show the children how to use Graphplot, prior to their using it in subsequent sessions with their own data. There was little evidence of the graph that was generated from this session being used to extend the children's maths work.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%		90%	10%
Mode	The children had already been taught how to generate graphs. This activity did not teach them anything new about data analysis or the drawing of graphs.			
	Category	**Repetition**	**Replacement**	**Extension**
	%	100		

22nd Jan	**SEN twins using typing tutor software on Acorn**			
Quantity	Manual Log: 17 minutes (17/300)			
	%	6%		
Focus	The focus was on learning how to touch type.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%		100%	
Mode	They had undertaken this same activity on previous occasions, and were repeating it in order to reach the stage where they did not have to think about how to type.			
	Category	**Repetition**	**Replacement**	**Extension**
	%	100		

22nd Jan	**'Groups' of children from Mrs Greens maths group entering their own data and printing out a graphical representation**			
Quantity	Manual Log: 40 minutes (40/300)			
	%	13%		
Focus	Focus on creating a graph from data they had collected. Some evidence of discussion of what the graphs told them about their data. Children still learning how to use software – having had a brief demo on the previous day.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%		30%	70%
Mode	The children already knew how to draw graphs of this sort and could have done this activity without the computer.			
	Category	**Repetition**	**Replacement**	**Extension**
	%	100		

23rd Jan	**Mrs Henry using the Acorn to produce a certificate**			
Quantity	Manual Log: 15 minutes before school. This gives a Quantity of 0% as the Quantity only applies to computer use during school time and that use must involve children in some way.			
	%	0%		
Focus	None – as Quantity is 0%			
	Category	**Pragmatic**	**Computing**	**Learning**
	%			
Mode	None – as Quantity is 0%			
	Category	**Repetition**	**Replacement**	**Extension**
	%			

23rd Jan	**SEN twins using typing tutor software on Acorn**			
Quantity	Manual Log: 15 minutes (15/300)			
	%	5%		
Focus	The focus was on learning how to touch type.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%		100%	
Mode	They had undertaken this same activity on previous occasions, and were repeating it in order to reach the stage where they did not have to think about how to type.			
	Category	**Repetition**	**Replacement**	**Extension**
	%	100		

23rd Jan	**Mrs Henry using the Acorn to produce a certificate**			
Quantity	Manual Log: 18 minutes during assembly. This gives a Quantity of 0% as the Quantity only applies to computer use that involves children in some way.			
	%	0%		
Focus	None – as Quantity is 0%			
	Category	**Pragmatic**	**Computing**	**Learning**
	%			
Mode	None – as Quantity is 0%			
	Category	**Repetition**	**Replacement**	**Extension**
	%			

23rd Jan	**Stephen writing answers to comprehension exercise on Pocketbook during English**			
Quantity	Manual Log: 45 minutes (45/300)			
	%	15%		
Focus	This activity was an integral part of the English lesson. Other children in the class were doing the same exercise on paper. The aim of the computer use seemed to be to enable Stephen to complete the activity, both by speeding up his writing and by helping to maintain his interest/focus on the task. Using the Pocketbook helped to maintain Stephen's interest/focus on the task and resulted in his being less disruptive/demanding. The quality of the final printout was also intended to overcome the stigma attached to Stephen's handwritten work. Stephen had used the PocketBook in this way many times before, so was familiar with how the software worked. Whilst he did know how to print out he needed help in connecting up his PocketBook to the printer.			
	Category	**Pragmatic**	**Computing**	**Learning**
	%	30%	10%	60%
Mode	This was an activity that all the other children were doing without the use of ICT, which would suggest it fell within the Replacement category, as Stephen was doing it on the computer rather than by hand. However, Stephen would not have been able to complete the activity within the lesson had it not been for the use of the computer. In that sense it extended what he was able to do.			
	Category	**Repetition**	**Replacement**	**Extension**
	%		50	50

23rd Jan	Children from Mrs Greens maths group entering their own data and printing out a graphical representation		
Quantity	Manual Log: 10 minutes (10/300)		
	%	3%		
Focus	Focus on creating a graph from data they had collected. Some evidence of discussion of what the graphs told them about their data. Children still learning how to use software – having had a brief demo two days previously.		
	Category	**Pragmatic**	**Computing**	**Learning**
	%		30%	70%
Mode	The children already knew how to draw graphs of this sort and could have done this activity without the computer.		
	Category	**Repetition**	**Replacement**	**Extension**
	%	100		

23rd Jan	Stephen and Mrs Henry writing up the results of the Science experiment on the Pocketbook		
Quantity	Manual Log: 15 minutes (30/300)		
	%	10%		
Focus	This was a finishing off session on Friday afternoon. The other children were doing the same activity on paper. Mrs Henry scribed for Stephen. The aim appeared to be to enable Stephen to complete the activity along with the other children – the use of the Pocketbook meant that it would not be obvious from the final product who had entered the text.		
	Category	**Pragmatic**	**Computing**	**Learning**
	%			100%
Mode	This activity could have been done without the Pocketbook, as was the case for all the other children. Mrs Henry could have scribed for Stephen on paper. Writing out the report of the Science experiment was not something Stephen had done before.		
	Category	**Repetition**	**Replacement**	**Extension**
	%		100	

Summary of the analysis of the computer use in Week 3

Date/Activity	19.1	20.1a	20.1b	21.1a	21.1b	22.1a	22.1b	23.1a	23.1b	23.1c	23.1d
Quantity											
Length (mins)	80	20	55	15	30	17	40	15	45	10	15
%	27	7	18	5	10	6	13	5	15	3	5
Focus											
Computing	10	100	0	0	90	100	30	100	10	30	0
Learning	10	0	100	100	10	0	70	0	60	70	100
Pragmatic	80	0	0	0	0	0	0	0	30	0	0
Mode											
Repetition	50	100	100	0	100	100	100	100	0	100	0
Replacement	50	0	0	100	0	0	0	0	50	0	100
Extension	0	0	0	0	0	0	0	0	50	0	0

The ratings for each of the activities were then weighted to take into account the number of children involved in the activity and the length of time it lasted.

Summary of the weighted ratings for each activity

Date	19.1	20.1a	20.1b	21.1a	21.1b	22.1a	22.1b	23.1a	23.1b	23.1c	23.1d
Length (mins)	80	20	55	15	30	17	40	15	45	10	15
No children	2	2	2	1	16	2	2	2	1	2	1
Quantity											
%	27	7	18	5	10	6	13	5	15	3	5
Focus											
Computing	533	1333	0	0	14400	1133	800	1000	150	200	0
Learning	533	0	3667	500	1600	0	1867	0	900	467	500
Pragmatic	4267	0	0	0	0	0	0	0	450	0	0
Mode											
Repetition	2667	1333	3667	0	16000	1133	2667	1000	0	667	0
Replacement	2667	0	0	500	0	0	0	0	750	0	500
Extension	0	0	0	0	0	0	0	0	750	0	0

These were then combined to establish the weighted rating each day for the computer use in 6TH against each of the dimensions of the CPF.

Summary of the weighted ratings for each day

Date	19-Jan	20-Jan	21-Jan	22-Jan	23-Jan	Total	Mean
Quantity							
%	27	25	15	19	28		**23**
Weighted Focus							
Computing	533	1333	14400	1933	1350	3910	**57**
Learning	533	3667	2100	1867	1867	2007	**29**
Pragmatic	4267	0	0	0	450	943	**14**
Weighted Mode							
Repetition	2667	5000	16000	3800	1667	5827	**85**
Replacement	2667	0	500	0	1250	883	**13**
Extension	0	0	0	0	750	150	**2**

Appendix H
Higher Education questionnaire

'Measures' of Computer Use Questionnaire

This questionnaire forms part of a project that is investigating ways of 'measuring' computer use in Higher Education (HE). The data will only be used for research purposes. The names of individuals and institutions will be treated as confidential.

Completing the questionnaire should take around 15 minutes on average.

The questionnaire is divided into five sections. Please read the introductory text at the beginning of each section carefully before answering the subsequent questions. Feel free to refer back to it as you answer the questions if you wish.

I would encourage you to write comments on the questionnaire as you fill it in; these might provide additional information that helps clarify your responses or might indicate ways in which the questionnaire could be improved.

I would be grateful if you could complete this questionnaire by Thursday 24th September. Questionnaires should be returned to Peter Twining in the pre-paid envelopes provided.

Many thanks.

Peter Twining
SoURCE Project Director

The School of Education
The Open University
Walton Hall
Milton Keynes MK7 6AA

Email: P.Twining@open.ac.uk

URLs
The SoURCE Project – http://mathetics.open.ac.uk/source/
The Open University – http://www.open.ac.uk/
The School of Education – http://soe.open.ac.uk/

Peter Twining Page 1

Section 1 – Course Details

As you go through this questionnaire you are asked to relate some of your answers to one specific **undergraduate course** that you are familiar with. This section asks for background information about that course.

1.1 Name of course

____

1.2 Subject area dealt with

____

1.3 Mode of delivery (Circle ONE item)

Traditional 'taught' course   Campus based flexible learning   Distance learning

1.4 Level of course (Circle ONE item)

Level 1   Level 2   Level 3

1.5 How long is the course?

__________________ (Specify units)

1.6 Breakdown of study hours

	Length (Hours)
Staff –student contact time (a)	
Student directed time (b) (i.e. time when students are doing 'set tasks' but the course tutor is not present)	
Other non-specified time (c) (i.e. any other time the students may spend studying not included in (a) or (b) above)	
Total (a + b + c) (i.e. Staff-student contact time + Student directed time + Other non-specified time)	

1.7 No. of CATS points (if appropriate)

____

1.8 Breakdown of (approximate) student numbers on this course

	Male	Female
Number of students	__________	__________

	Full time	Part time
Number of students	__________	__________

Number of mature students __________

Please provide any additional information about this course that you consider important and feel free to comment on any aspect of Section 1.

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Section 2 - Quantity of computer use

This section of the questionnaire deals with the amount of time **students** spend using computers on undergraduate level courses.

In answering questions 2.1 to 2.3 below focus on the specific undergraduate course that you identified in Section 1.

2.1 How much time would a typical student spend using computers as part of their work on this course?

	Minimum (hours per week)	**Maximum** (hours per week)	**Average** (hours per week)
During contact time (a)			
During directed time (b)			
At any other time (c)			
Total (a + b + c)			

2.2 Which of these best describes the frequently of computer use on this course? (Circle ONE descriptor)

Daily / Weekly / Fortnightly / Monthly / Occasionally / Never

2.3 How would you rate the quantity of computer use for this course on the scale below? (Circle ONE descriptor)

None **Not much** **Some** **Quite a lot** **Lots**

2.4 Indicate what you would consider to be reasonable interpretations of the words None, Not much, Some, Quite a lot, and Lots when referring to the quantity of use of computers on a **typical undergraduate course**?

	Minimum quantity (hours per week)	**Maximum quantity (hours per week)**
None		
Not much		
Some		
Quite a lot		
Lots		

Please provide any additional information about quantity of computer use that you consider important and feel free to comment on any aspect of Section 2.

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Section 3 - Focus of computer use

Focus deals with the **intentions** behind computer use in teaching. For the purposes of this research there are three possible foci, which are described below. It is important to bear in mind that any one activity may have more than one focus; foci are NOT mutually exclusive.

The three possible foci are:-

Pragmatic - practical or managerial reasons for using the computer. Not focused on learning but on some other aspect of the teaching situation.

E.g. Using IT in order to be seen to be using it.
E.g. Allowing students to use the computer as a motivator.
E.g. Encouraging students to use computers to produce assignments in order to increase their legibility.

Computer Literacy - using the computer in order to extend the students' knowledge, understanding or skill in computer use. i.e. to learn about some aspect of the computer or how to operate it.

E.g. Using the computer in order to learn how to use the word processing software.

Learning Tool - using the computer to support the students' learning in some area other than computing.

E.g. To help them enhance their writing skills through drafting and re-drafting.
E.g. To extend their ability to analyse numerical data.

All three foci will apply to some extent if you are using the computer (even if the extent to which they apply is None!). E.g. If students are using a statistical analysis package to manipulate some data the aims might include:

- Being seen to be using the computers as much as possible in order to justify your need for the equipment to be upgraded (i.e. *Pragmatic*).
- Teaching the students how to use a particular stats. package (i.e. *Computer Literacy*).
- Explaining some aspect of statistical analysis to students (i.e. *Learning Tool*).

3.1 Indicate the extent to which each focus generally applies to computer use on the course you identified in Section 1. (Circle ONE descriptor ONLY IN EACH ROW)

Pragmatic	None	Not much	Some	Quite a lot	Lots
Computer Literacy	None	Not much	Some	Quite a lot	Lots
Learning Tool	None	Not much	Some	Quite a lot	Lots

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3.2 Indicate what you would consider to be reasonable interpretations of the words None, Not much, Some, Quite a lot, and Lots when referring to the focus of computer use on a **typical undergraduate course**?

	Minimum % to which it applies	**Maximum % to which it applies**
None		
Not much		
Some		
Quite a lot		
Lots		

Use the space below to provide any additional information about the focus of computer use that you consider important or to comment on any aspect of Section 3.

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Section 4 - Mode of computer use

Mode deals with the actual implementation of computer use in your teaching - how the computer is used. For the purposes of this research there are three possible modes of computer use:

Repetition - where the computer is being used to repeat something which the students already 'know/understand/can do' (either on or off the computer). i.e. The students are repeating an activity that they have done before (though the context previously may not have been on the computer).

E.g. Generating graphical representations of data when the students already know how to draw such representations by hand.

E.g. Generating graphical representations of data when the students have already learnt how to draw such representations on the computer (even if they do not know how to draw them by hand).

Replacement - where the computer is being used to do something which the students have not done before (either on or off the computer) and which could have been done without a computer.

E.g. Learning how to carry out a statistical analysis on the computer (when they have never learnt how to do this before either on or off the computer).

Extension - where the computer is being used to do something which **could not** have been done without a computer or which **would not** have been done if it were not for the computer in the context of your teaching.

E.g. Having an ongoing discussion with remote experts (via computer conferencing).

E.g. Explicitly teaching the students how to work collaboratively as members of a group.

4.1 Indicate the extent to which each mode applies to computer use on the course you identified in Section 1 (on average). (Circle ONE descriptor ONLY IN EACH ROW)

Repetition	None	Not much	Some	Quite a lot	Lots
Replacement	None	Not much	Some	Quite a lot	Lots
Extension	None	Not much	Some	Quite a lot	Lots

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4.2 Indicate what you would consider to be reasonable interpretations of the words None, Not much, Some, Quite a lot, and Lots when referring to the mode of computer use on a **typical undergraduate course**?

	Minimum % to which it applies	**Maximum % to which it applies**
None		
Not much		
Some		
Quite a lot		
Lots		

Use the space below to provide any additional information about the mode of computer use that you consider important or to comment on any aspect of Section 4.

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Section 5 - Background information

This section asks for information about the person filling in this questionnaire.

This data will be treated as confidential. Names of individuals and institutions will not be used in any reporting of this research and will not be divulged to other parties.

5.1 Your Name

Title (Dr/Mrs/etc)	**Calling (First) Name**	**Family (Surname) Name**
______	______	______

5.2 Your Email address ______

5.3 Your Gender

Female Male

5.4 Your age band

Under 30 30 to 39 40 to 49 50 to 60 Over 60

5.5 Name of your institution ______

5.6 Your Department ______

5.7 Your Position/Role ______

5.8 Your Subject area ______

5.9 Are you willing for the researcher to contact you in the future with regard to this research?

Yes No

Please provide any additional information about yourself that you consider important and feel free to comment on any aspect of Section 5.

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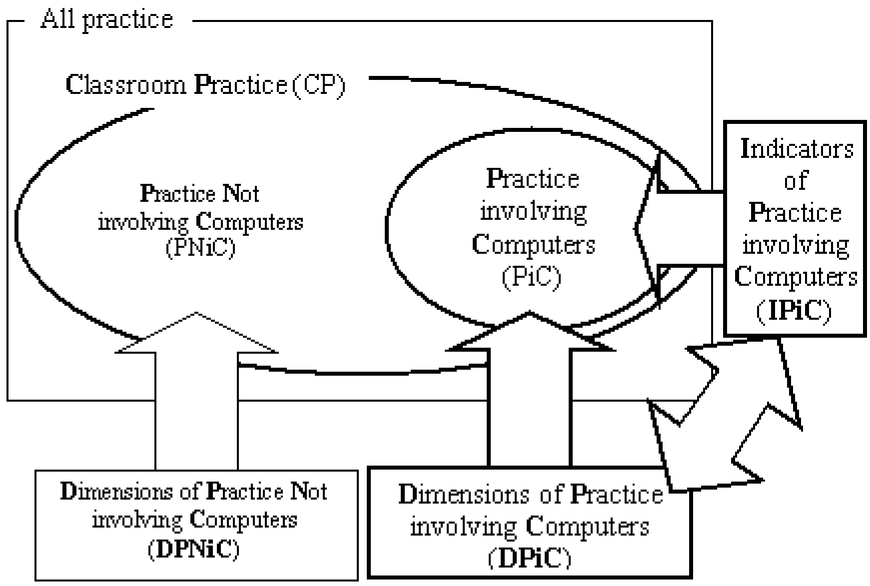
Appendix I
ITTE Focus Group handouts

Handout 1 - The Research Problems



Classroom practice = Practice involving computers + Practice not involving computers

$$CP = PiC + PNiC$$

Problem 1 Develop indicators of PiC (IPiCs).

Problem 2 Are IPiCs reliable?

Problem 3 Are IPiCs valid?

Identify dimensions of PiC (**DPiCs**).

$$DPiC \Leftrightarrow PiC$$

If IPiCs are valid then IPiCs will map onto DPiCs (If IPiCs change DPiCs must change and visa versa).

$$IPiC \Leftrightarrow DPiC$$

Handout 2 - The Indicators (IPiC) & Reliability

Problem 1 Develop indicators of PiC (IPiC).

1 Quantity

This is purely a measure of how much of the school day one or more computers are in use by children from your class.

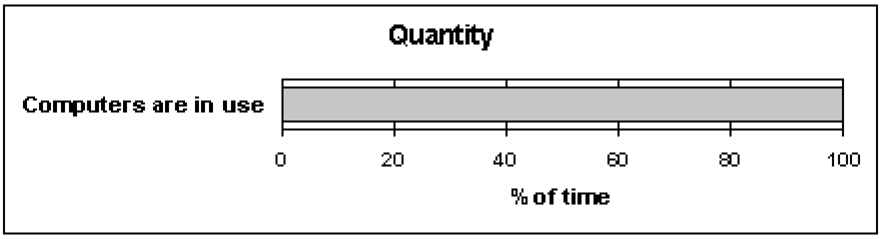
The school day is taken to mean time when children are in school but excluding play times, lunch times, after school clubs etc..

The number of children using a computer is irrelevant (for this indicator).

The number of computers in use is irrelevant (for this indicator).

If a computer is being used with children (even if they are not controlling the keys/mouse) that counts as it being used by the children.

Indicate on the diagram below the **percentage of each day** for which **one or more computers** are **in use with your children**, on **average**.



2 Focus

This IPiC deals with the reasons **why you use a computer** with your children.

If IPiC Quantity = 0% (i.e. you are not using computers with your children) then this IPiC (Focus) does not apply.

For the purposes of this research we have divided all the possible reasons for using a computer in your class into three categories:

IT - Using computers in order to *learn about computers*. Thus the focus here is on using a computer in order to extend the children's knowledge, understanding or skill in computer use.

E.g. Using the computer in order to learn how to operate the mouse.
E.g. Using the computer in order to learn how to use the word processing software.

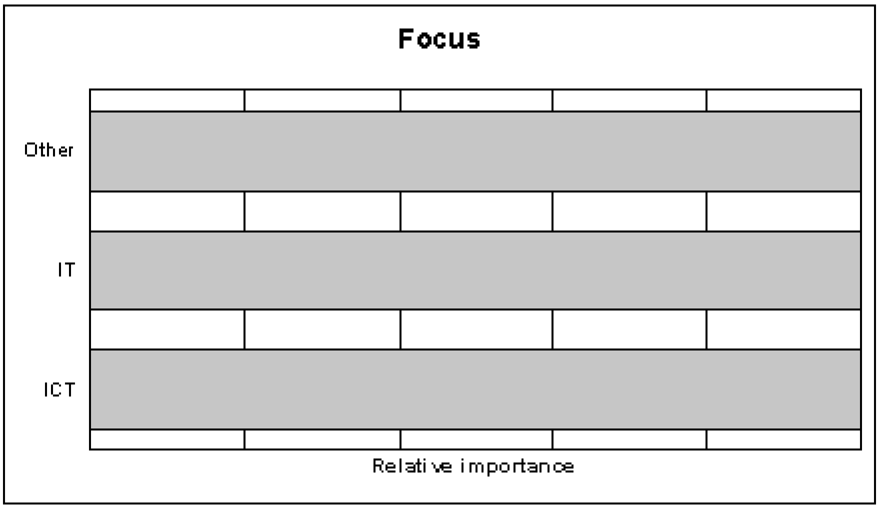
ICT - Using computers as tools to help children *learn about something else*.

E.g. To help them develop the language skills involved in drafting and re-drafting.
E.g. To extend their ability to interpret graphs (i.e. mathematics).

Other - Using the computer for *some other reason*. Reasons for using computers that fall within this category are not focused on learning but on some other aspect of the classroom situation.

E.g. Using IT in order to be seen to be using it.
E.g. Allowing children to use the computer as a reward or filler activity.

Indicate on the diagram below the relative importance of each category on average.



3 Mode

This IPiC looks at **how computers are used** in your class.

If IPiC Quantity = 0% (i.e. you are not using computers with your children) then this IPiC (Mode) does not apply.

For the purposes of this research there are four ways of using computers with children.

Repetition - where the computer is being used to repeat something which the students already 'know/understand/can do' (either on or off the computer). i.e. The students are repeating an activity that they have done before (though the context previously may not have been on the computer).

E.g. Generating graphical representations of data when the students already know how to draw such representations by hand.
E.g. Generating graphical representations of data when the students have already learnt how to draw such representations on the computer (even if they do not know how to draw them by hand).

Replacement - where the computer is being used to do something which the students have not done before (either on or off the computer) and which could have been done without a computer.

E.g. Learning how to carry out a statistical analysis on the computer (when they have never learnt how to do this before either on or off the computer).

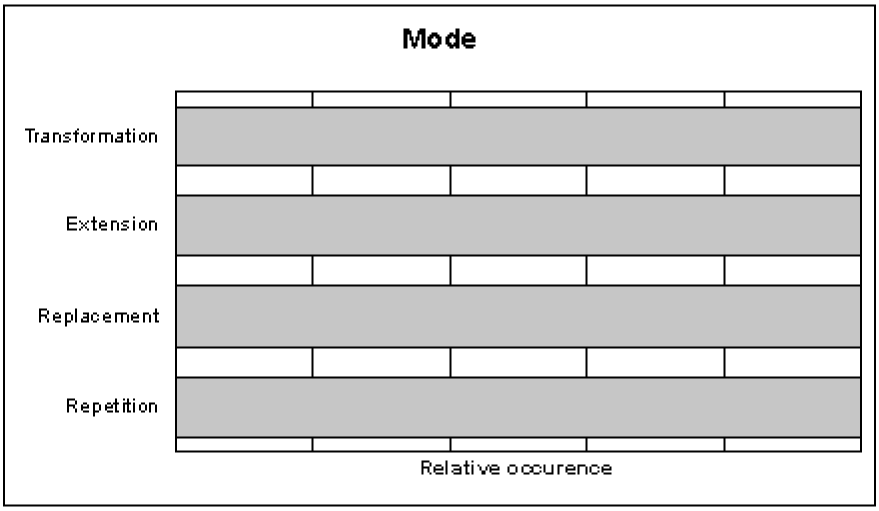
Extension – where the computer is being used to do something which extends the curriculum or pedagogy within the classroom but which would have been seen as being valuable without computers. i.e. you are doing something that would not have been practically possible within the classroom without a computer but which would have been valued as part of practice if it were possible.

E.g. Writing for a real audience in another country (using email).
E.g. Having an ongoing discussion with remote experts (via computer conferencing).
E.g. Using a simulation to explore 'being' a racing driver or an underwater archaeologist.

Transformation – where the computer is transforming the curriculum or pedagogy. i.e. you are doing something that extends the curriculum and/or pedagogy that you could not and/or would not have done if it were not for computers.

E.g. Increasing the literacy skills that children deal with to include understanding multimedia 'texts'.
E.g. Explicitly teaching the children how to teach each other (if this is something that you would not have previously done in any other context).

Indicate on the diagram below the relative degree to which each of these categories applies for your children on average.



Problem 2 Are the indicators (IPiCs) reliable?

In order to be reliable they need to be applied in the same way by a range of people over time/cases.

Key questions that need to be answered for each of the three IPiCs are:

1. Are they understandable?
2. Are they clear and unambiguous?
3. Are they operable?
4. Is this sufficient to claim reliability? (And if not what else is required?)

Handout 3 - Dimensions of Practice involving Computers

Handout 3 pages 2 to 23 are not reproduced here. They are very similar to the initial questionnaire used in Case Studies 4 & 5 – see Appendix D.

Appendix J
ITTE Focus Group response sheets

Response Sheet.doc ITTE 'Measures' Workshop July 1999

Response Sheets

Problem 2 Reliability of indicators of PiC (IPiCs)

1 Quantity (Handout 2 page 1)

A Is it understandable? Yes / No

If you answered No to A - how could it be made easier to understand?

B Is it clear and unambiguous? Yes / No

If you answered No to B - how could it be made clearer and/or less ambiguous?

C Is it operable? Yes / No

If you answered No to C - how could it be made more operable?

D If you have answered Yes to A, B & C or I took into account your suggestions for improving this indicator would that be sufficient in order to claim it was reliable? Yes / No

If you answered No to D - what else do I need to do?

Please write CLEARLY! Page 1 of 8

ITTE 'Measures' Workshop July 1999 Response Sheet.doc

2 Focus (Handout 2 page 2)

A Is it understandable? **Yes / No**

If you answered No to A - how could it be made easier to understand?

B Is it clear and unambiguous? **Yes / No**

If you answered No to B - how could it be made clearer and/or less ambiguous?

C Is it operable? **Yes / No**

If you answered No to C - how could it be made more operable?

D If you have answered Yes to A, B & C or I took into account your suggestions for improving this indicator would that be sufficient in order to claim it was reliable? **Yes / No**

If you answered No to D - what else do I need to do?

Page 2 of 8 **Please write CLEARLY!**

Response Sheet.doc ITTE 'Measures' Workshop July 1999

3 Mode (Handout 2 page 3-4)

A Is it understandable? **Yes / No**

If you answered No to A - how could it be made easier to understand?

B Is it clear and unambiguous? **Yes / No**

If you answered No to B - how could it be made clearer and/or less ambiguous?

C Is it operable? **Yes / No**

If you answered No to C - how could it be made more operable?

D If you have answered Yes to A, B & C or I took into account your suggestions for improving this indicator would that be sufficient in order to claim it was reliable? **Yes / No**

If you answered No to D - what else do I need to do?

Please write CLEARLY! Page 3 of 8

ITTE 'Measures' Workshop July 1999 Response Sheet.doc

Problem 3 Validity of indicators of PiC (IPiCs).

If the IPiCs are valid then they will map onto the DPiCs. Thus if IPiCs change DPiCs must change and visa versa.

IPiCs ⇔ DPiCs

1 Identifying the DPiCs (Handout 3)

A Are there any dimensions of practice involving computers missing from the set summarised on Page 1 of Handout 3? Yes / No

If you answered Yes to A - please detail any missing dimensions below:

B Are any of the dimensions listed in Handout 3 unnecessary? Yes / No

If you answered Yes to B - please cross out any that you think are unnecessary on the list opposite (p5 of this booklet).

C On the list opposite (p5 of this booklet) please indicate the relative importance of each of the dimensions.

Page 4 of 8 **Please write CLEARLY!**

Response Sheet.doc ITTE 'Measures' Workshop July 1999

List of Dimensions of Practice involving Computers

Dimension Name	Importance[1]	Ranking
Number of computers		
Size of class		
Quantity of computer use		
Curriculum - Content		
Curriculum - Emphasis		
Curriculum - Access		
Curriculum - Progression		
Use of class time - Distribution		
Use of class time - Flexibility		
Use of teacher's time before sessions - Planning		
Use of teacher's time before sessions - Preparing		
Use of teacher's time during sessions - Quantity		
Use of teacher's time during sessions - Distribution		
Use of teacher's time after the session - Recording		
Use of other adults' time		
Use of space - Location		
Use of space - Quantity		
Use of space - Quality		
Group composition - Size		
Group composition - Basis		
Group composition - Control		
Group composition - Function		
Ways of working		
Audience		
Control		
Teacher fallibility Sources of expertise		
Sources of information		
Access to information		
Teacher's questions		
Assessment - Extent		
Assessment - Method		
Assessment - Content		
Recording - Extent		
Recording - Method		
Recording - Content		
Reporting - Extent		
Reporting - Method		
Reporting - Content		
IT competence required - By Teacher		
IT competence required - By Children		

[1] Please make it clear how you are indicating the importance.
E.g. * = Not important, to ***** = Very important or 1 = Not important, to 5 = Very important

Please write CLEARLY! Page 5 of 8

ITTE 'Measures' Workshop July 1999 Response Sheet.doc

D Note here any observations on the descriptions and categorisations of the dimensions. Please clearly specify which dimension(s) you are referring to.

E How could the dimensions (as listed in Handout 3) be further simplified so that they are easier to apply?

F Note here any other comments about my dimensions of practice involving computers.

Page 6 of 8 **Please write CLEARLY!**

Page 7 was left blank, except for a message saying that respondents should feel free to use it to add any comments or notes about the Indicators (IpiCs), Descriptors (DpiCs) or the research in general.

General Info

Q1 Do you know of relevant 'literature' that I should be aware of? **Yes / No**

If you answered Yes to Q1 please note down details here - or provide your contact details in Q5 below so I can contact you later!

Q2 Would you be willing and able to provide me with access to ITT students who I could trial my 'measures' on? **Yes / No**

Q3 Would you be interested in having further involvement with this research? **Yes / No**

If you answered Yes to Q3 what sort of involvement might you be interested in?

Q4 Would you like to be kept informed of developments with this research? **Yes / No**

Q5 If you happy for me to contact you to follow up your responses then please provide your name & email address below.

Name ______________________

Email Address ______________________

 Please write CLEARLY!

Appendix K
Case Study 6: Sample Manual Log

Class: **4SL**

Computer Log

Week beginning: ____________

Monday	Quantity		B		L	
	Focus					
	Mode					
Tuesday	Quantity		R		U	
	Focus					
	Mode					
Wednesday	Quantity		E		N	
	Focus					
	Mode					
Thursday	Quantity		A		C	
	Focus					
	Mode					
Friday	Quantity		K		H	
	Focus					
	Mode					

Computer Log.doc

Appendix L
Case Study 6 – Analysis of each activity against the Computer Practice Framework

Researcher's analysis of individual activities that he observed in CS6

Date	08/05/	09/05/a	09/05/b	12/05/a	12/05/b	12/05/c	
Software	Anglo Saxons	Anglo Saxons	Dazzle	Anglo Saxons	Dazzle	Creative Writer	
No children	3	3	14	3	14	1	
Quantity							**Weighted Quantity**
Length (mins)	1:30	0:55	0:55	1:00	1:00	0:20	
%	30	18	18	20	20	7	14
Focus							
IT	40	30	70	30	40	0	
Learning Tool	50	70	20	70	50	0	
Other	10	0	10	0	10	100	
Mode							
Repetition	70	100	0	100	0	100	
Replacement	0	0	0	0	0	0	
Extension	30	0	100	0	100	0	
Transformation	0	0	0	0	0	0	
Weighted Focus							**Focus**
IT	3600	1650	17967	1800	11200	0	48
Learning Tool	4500	3850	5133	4200	14000	0	42
Other	900	0	2567	0	2800	667	9
Weighted Mode							**Mode**
Repetition	6300	5500	0	6000	0	667	25
Replacement	0	0	0	0	0	0	0
Extension	2700	0	25667	0	28000	0	75
Transformation	0	0	0	0	0	0	0

Continued on next page

Teacher's analysis of individual activities in CS6

			Activities observed by researcher													
Date	**04/05**	**05/05**	**08/05**	**09/05 a**	**09/05 b**	**12/05 a**	**12/05 b**	**12/05c**	**17/05**	**19/05**	**23/05**	**26/05**	**08/06**	**27/06**	Mean - viewed Amalgamated	Mean - all Amalgamated
Software	**Harry PkBk**	**Harry PkBk**	**Anglo Saxons**	**Anglo Saxons**	**Dazzle**	**Anglo Saxons**	**Dazzle**	**Creative Writer**	**WP**	**WP**	**Dazzle**	**Dazzle**	**Internet**	**Pointillist**		
No children	1	1	3	3	14	3	14	1	2	2	14	14	14	14		
Quantity																
Length (mins)	5:00	5:00	1:30	0:55	0:55	1:00	1:00	0:20	0:40	0:20	0:55	0:55	1:00	1:00	Weighted	Weighted
%	100	100	30	18	18	20	20	7	13	7	18	18	20	20	14	8
Focus																
IT	0	0	40	40	90	30	40	20	0	0	90	40	60	50	43	36
Learning Tool	100	100	50	50	10	70	50	10	0	0	10	50	40	50	40	42
Other	0	0	10	10	0	0	10	70	100	100	0	10	0	0	17	22
Mode																
Repetition	100	100	60	100	0	100	0		50	50	0	0	0	50	52	47
Replacement	0	0	40	0	0	0	0		50	50	0	0	0	0	8	11
Extension	0	0	0	0	100	0	100		0	0	100	100	0	0	40	31
Transformation	0	0	0	0	0	0	0		0	0	0	0	100	50	0	12
Weighted Focus															Weighted	Weighted
IT	0	0	3600	2200	23100	1800	11200	133	0	0	23100	10267	16800	14000	56	52
Learning Tool	10000	10000	4500	2750	2567	4200	14000	67	0	0	2567	12833	11200	14000	38	43
Other	0	0	900	550	0	0	2800	467	2667	1333	0	2567	0	0	6	5
Weighted Mode																
Repetition	10000	10000	5400	5500	0	6000	0	0	1333	667	0	0	0	14000	23	26
Replacement	0	0	3600	0	0	0	0	0	1333	667	0	0	0	0	5	3
Extension	0	0	0	0	25667	0	28000	0	0	0	25667	25667	0	0	72	51
Transformation	0	0	0	0	0	0	0	0	0	0	0	0	28000	14000	0	20

Appendix M
Reliability testing instructions

CPF Reliability Testing Instructions.doc Instructions

Is the Computer Practice Framework reliable?

Thank you for agreeing to take part in this round of testing of the Computer Practice Framework (CPF).

What should be included in this pack:

- This set of instructions!
- A set of documents containing data about one Yr4 class' use of computers during the summer term 2000.
- A 'response sheet'.
- A pre-paid SAE for returning the 'response sheet' to Peter Twining.

What you need to do:

Read through these instructions once. They should give you a general feel for how to apply the Computer Practice Framework. Please resist the temptation to critique the CPF at this stage! (You will have a chance to do that later if you wish)

Having read through these instructions read the document headed CS6 Context.

Then flick through the plans, timetable and computer log sheets to get a general feel for what the teacher planned to do over the summer term and the computer use that she recorded.

You are then ready to start to respond to the questions on the 'response sheet'. As you respond to them feel free to refer to any of the documentation that you have been provided with that you think is relevant.

Remember as you fill in the 'response sheet' that your responses should always refer to what 'actually' happened/was implemented, which may or may not be the same as what was planned and/or reported.

If you find that there is insufficient space on the 'response sheet' to explain your judgements feel free to write on the back of the sheets. Please write legibly - my ability to read hand-written text has atrophied!

Please resist the temptation to confer with anyone else over your judgements - the aim of this little experiment is to see the extent to which different people come up with the same judgements when applying the CPF.

When you have finished filling in the response sheet please return it to me.

Many thanks. If any of the instructions are not clear please let me know.

Peter Twining

P.Twining@open.ac.uk

Page 1 of 4

Working out the Focus of computer use

The Focus deals with the objectives that the computer use sustains, when it is implemented. The possible objectives for using a computer are sub-divided into three categories on the Focus dimension:

IT **- Using computers in a way that helps children to develop their ICT skills, knowledge and understanding.** The emphasis here is on using a computer to extend the children's knowledge, understanding or skill in computer use itself.

E.g. Learning how to operate the mouse.
E.g. Learning how to use the word processing software.

Learning Tool **- Using computers in a way that supports any aspect of children's learning other than ICT itself.** This would include the following three areas:

Curriculum Tool - Using computers as tools in a way that helps children to develop skills, knowledge and understanding in another curriculum area (i.e. other than ICT). The emphasis here is on using the computer as a tool to enhance their learning in another curriculum area rather than in the area of IT itself.

E.g. To develop the language skills involved in drafting and re-drafting.
E.g. To extend their ability to interpret data (e.g. using a graphing package that they already know how to operate to help them answer a Scientific hypothesis).
E.g. To provide access to the curriculum (e.g. for children with 'Special Needs').

Mathetic Tool - Using computers as tools to develop children's ability to learn and enhance their approaches to learning.

E.g. To encourage collaboration.
E.g. To help children reflect on their own learning processes.
E.g. To teach children to teach each other how to use particular programs.

Affective Tool - Using computers as tools to support and enhance the affective aspects of children's learning.

E.g. To develop their confidence and/or self-esteem (for example by allowing a child who may be perceived as 'less able' to teach other children how to use a new program).
E.g. Using computers to help motivate children.

Other **- Using the computer for some other reason (i.e. not covered by** ***IT*** **or** ***Learning Tool*****).** Reasons for using computers that fall within this category may be focussed on practical aspects of the learning situation or the larger context in which the computer use is taking place.

E.g. Using computers in order to respond to pressure to do so from children, their parents and/or colleagues.
E.g. Allowing children to use the computer as a reward or holding activity whilst the teacher is working elsewhere. An example of this would be allowing children who have finished other work to 'go on the computer'.
E.g. Using a computer in order to make the teacher's workload or classroom management easier or more enjoyable.
E.g. Using computers as a mechanism for presenting the school in a good light or in order to be seen to be using them.

The Focus continued

At any one time all three foci always apply to some degree. Any classification of computer use on the Focus dimension is likely to involve each category simultaneously to some degree because:

The teacher always has to consider management issues when planning and allocating activities (*Other*);

One cannot focus on learning to use a computer (*IT*) in isolation from some content, which inevitably will be from part of some other curriculum area (*Learning Tool*);

When using a computer to do something else (*Learning Tool*) learning and/or reinforcing of computing skills (*IT*) takes place;

Learning to become more effective learners (*Learning Tool*) should be an implicit part of teaching;

Any learning episode always entails an element relating to the affective nature of the task (*Learning Tool*).

The key to the Focus dimension is the relative extent to which each of these three aspects applies.

It is important when thinking about the Focus to distinguish between what a teacher would like the objectives to be, what she plans the objectives to be, and what they are when the activity is implemented. For example, a teacher may identify the reason for computer use as being predominantly as a tool to enhance children's learning in English (i.e. *Learning Tool*) whilst an observer might note that the children spent all of their time learning how to operate the software (i.e. *IT*). **Focus (and indeed the whole of the CPF) is concerned with what actually happens when a computer is used, not what was intended.**

The Focus of use will alter over time, even within the same activity. Thus, when deciding on the relative weighting of each of the aspects on the Focus dimension you have to **take an average weighting over the time period that you are interested in**.

Working out the Quantity of computer use

In order to work out the quantity of computer use you need to calculate the number of minutes during which one or more computers are used by one or more children during the school day. In doing this calculation:

- The school day is taken to mean time when children are in school but excludes play times, lunch times, after school clubs etc.;
- If a computer is being used with children (even if they are not controlling the keys/mouse) that counts as it being used by the children.

CPF Reliability Testing Instructions.doc Instructions

Overview of the Mode dimension

The Mode dimension is concerned with the impact that computers use has on the curriculum within the context being described. The curriculum is taken here to include all aspects of practice surrounding computer use:

- The content (including but going beyond the explicit curriculum as set down in guidelines/curriculum documents but excluding the ICT curriculum);
- The processes.

Mode	**Curriculum**			**Summary**
	Content (Learning objective ignoring ICT objectives)		**Process** (How they learn)	
Support	Same	and	Automated but otherwise essentially unchanged	More efficient or effective without changing content
Extend	Different - but *does not require* a computer	and/or	Different - but *does not require* a computer	Changes content and/or process but could have been achieved in a 'classroom' without a computer
Transform	Different - and *requires* a computer	and/or	Different - and *requires* a computer	Changes content and/or process and could *not* have been achieved in a 'classroom' without a computer

Figure 1 **Summary of key distinctions between the three modes of computer use within the Computer Practice Framework (CPF)**

Working out the Mode for any single activity

Answering the questions below for any one activity will identify which Mode applies to it.

		Answer = No	**Answer = Yes**
1	Has *what* the children are learning changed?	Go to 2	Go to 3
2	Is automation the only change to the *process* through which the children learn in this activity?	Go to 3	Mode is Support
3	Could you do this in a school context without a computer?	Mode is Transform	Mode is Extend

Working out the Mode over a range of activities

In making an overall judgement about the Mode of computer use in a classroom, which spans more than one computer activity, you take an average across all the activities. Eg Act 1 - Transform. Act 2 - Extend, Act 3 - Support, Act 4 - Support. Overall Support 50%, Extend 25%, Transform 25%.

Page 4 of 4

Appendix N
Reliability testing scenarios

List of documents provided to respondents

Description of context

Scheme of work (2 Overview planning sheets)
Timetable (1 page)
Weekly plans (2nd May to 7th July)
Computer logs (2nd May to 20th July)

Scenario 1
Transcript 1.1: Researcher talking to Tina
Transcript 1.2: Researcher talking to Tina

Scenario 2
Transcript 2.1: Researcher talking to Tina
Transcript 2.2: Researcher talking to Mrs Light

Scenario 3
Transcript 3.1: Researcher talking to ??
Transcript 3.2: Researcher talking to Mrs Light

Description of the context

CS6 Context.doc CS6 Context

CS6 The context

Lakeside[1] is a two form entry county combined school. There are approximately 60 children in each year group. As with all schools in the LEA children start school in the term in which they are 5 and leave for secondary school at the end of Yr7. The school was built in 1988. It is a single story building, which houses 16 'home bases' built around shared areas. The school building is divided into two sections, with the staff room, offices, music room and hall in the middle. Rising Fives through to Yr3 occupy one section of the building with Yrs 4 to 7 in the other section. The school is situated in spacious grounds, including two tarmac playgrounds and a playing field.

Lakeside has 17 teachers and 8 teaching support staff. The headteacher took up his post in 1995. He is enthusiastic about IT and took over the role of IT co-ordinator in 1999 on the departure of its previous incumbent.

NGfL funding helped Lakeside to investment significantly in the provision of additional computers throughout the school. This included setting up three additional computers for staff use in the staff room and the establishment of a network of seven PCs, with Internet connection, in the 'Junior' section of the school. The school was burgled on two separate occasions between September 1998 and December 1999. On each occasion significant amounts of computer equipment were stolen.

The Case Study 6 class (4SL) was a Y4 class (8 - 9 year olds) with 27 pupils in it (17 girls and 10 boys). The class teacher (Mrs Light) held the post of responsibility for English within the school.

During the Summer Term, when Case Study 6 took place, 4SL had access to:

- four computers in the shared area directly outside the classroom (See Photo 1)
- seven computers in a peer-to-peer network in the upper school shared area, which is just around the corner from the classroom (See Photo 2)
- two computers outside the Y7 class
- approximately 20 Psion pocket books, shared across the whole school and stored in the head teacher's office
- 1 Psion pocket book for use by one particular child in the class as part of his SEN provision

All of the desktop computers that 4SL had access to were organised in 'clusters', located outside the classroom (see Photos 1 and 2).

hoto 1 Four computers outside 4SL (which can be seen in the background to the right of the picture)

Photo 2 Seven computers in a peer-to-pee network in the upper school share area

[1] All names (e.g. school, teacher, children) have been changed in order to protect their identities.

Page 1 of 1

Scheme of work – example sheet

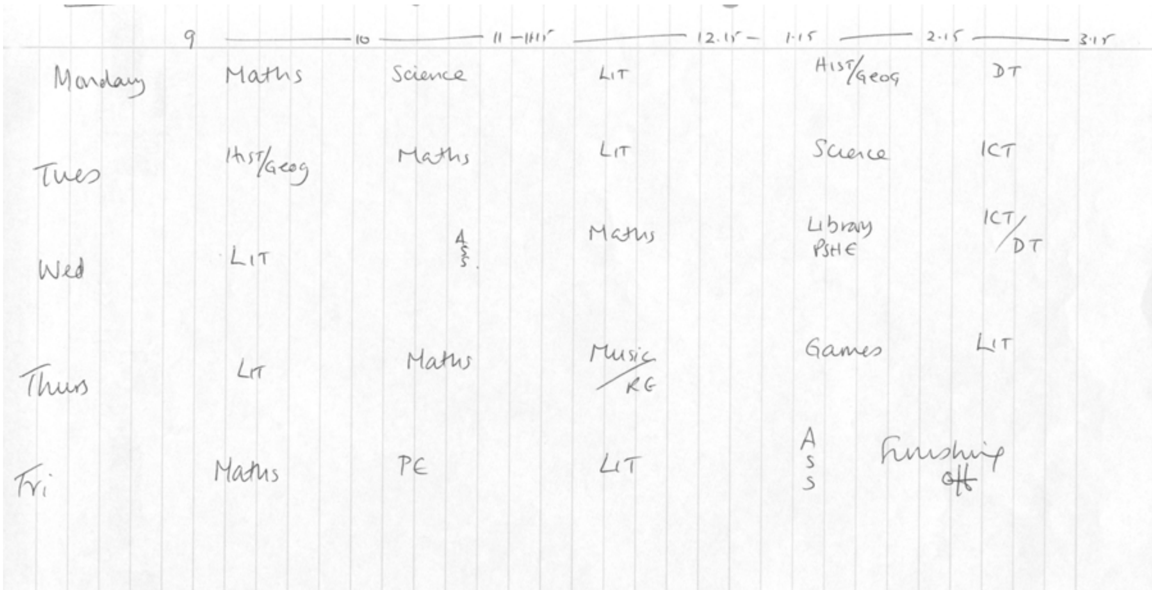
ICT could be in evidence.

Year 4 Overview Planning Sheet - Summer 2000 (1)

	Literacy	Maths	Science	ICT	D and T	History	Geog.	Art	Music	PE	Games	RE	PSHE
1st May	Follow NLS Guidelines See short term plans.	Follow NNS Guidelines See short term plans.	Brainstorm and experiment to see what children know about circuits and their components.	Review cut and stick. Look at repeating wrapping paper.	Investigating Torches- Variety, uses, materials and designs.	Investigating Sutton Hoo objects in relation to Anglo/Saxon life.	Walk to River – sketch and illustrate. Label main features.	Historical 3D art activities – to include A/S face mask. A/S warrior. A/S Boats Papermache figures.	(Alternate weeks) Composing and practising a piece of music for presentation	Atheletic preparations and activities.	Fielding and striking games – techniques, strategies and games.	(Alternate weeks) Identify person who is admired. Sikhs – Guru Nanak	What makes me feel sad? Unsure? Lonely? Em-barrassed?
8th May			Materials used in electric circuits- Conductors Insulators	Use stamps on computer to create wrapping paper	When where and who use torches. How do they differ?		Feedback and Evaluation.		To the year group. Theme Beowulf				When do other people feel sad? Unsure? Lonely? Em-Barassed?
15th May			Making switches to make or break circuits, their functions	Pointillist effects- Optical illusions - sizing of paint brushes.	FPT's from QCA happening within science.		.	Sketch for ICT pointillism				Personal experience which gave rise to feelings of pride or shame.	SATS
22nd May			Adding extra batteries to circuits plus prediction. Changing components predict results.	Pointillist sketch on computer.	How torches work? - disassemble and investigate								What do loss and separation feel like?

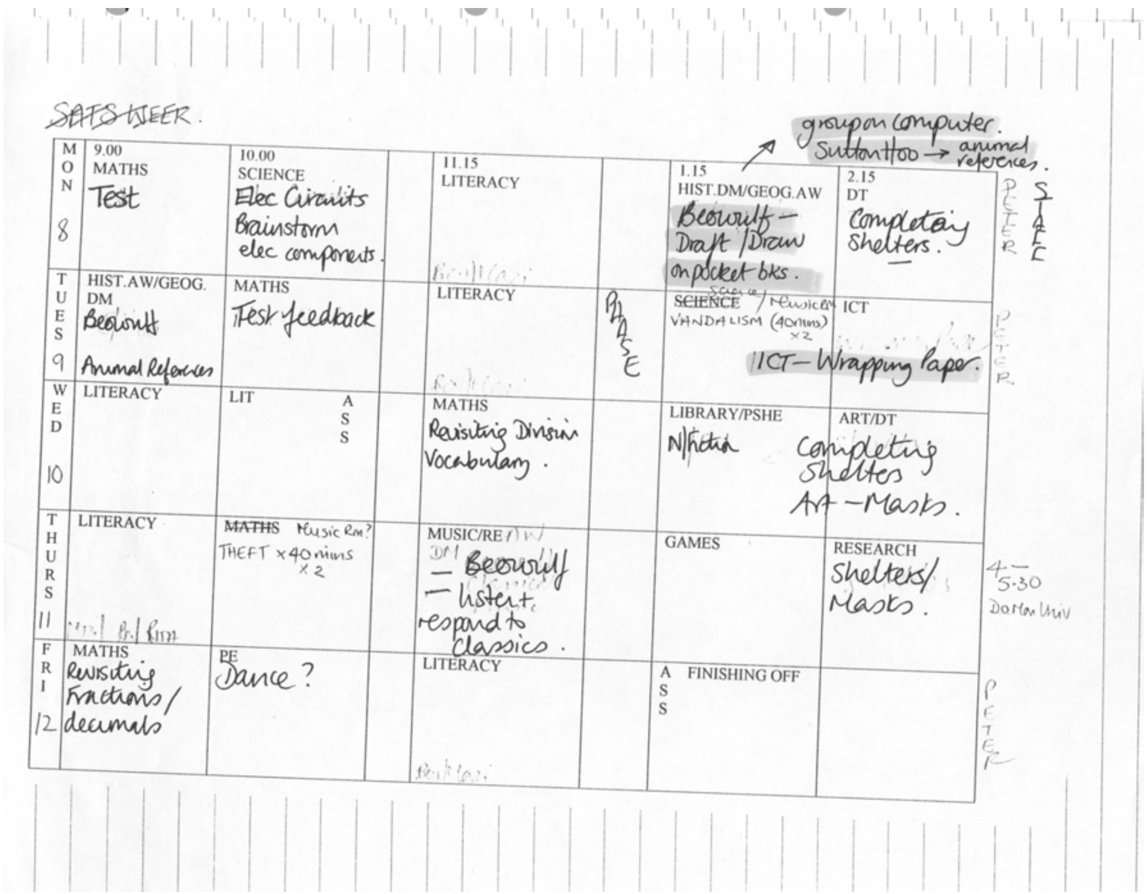
SAT NK.

Timetable



	9	10	11 – 11.15	12.15 – 1.15	2.15 – 3.15
Monday	Maths	Science	LIT	Hist/Geog	DT
Tues	Hist/Geog	Maths	LIT	Science	ICT
Wed	LIT	ASS	Maths	Library PSHE	ICT/DT
Thurs	LIT	Maths	Music/RE	Games	LIT
Fri	Maths	PE	LIT	ASS	Finishing off

Weekly plan – example



~~SATS WEEK~~.

group on computer. Sutton Hoo → animal references.

MON 8	9.00 MATHS Test	10.00 SCIENCE Elec Circuits Brainstorm elec components.	11.15 LITERACY		1.15 HIST.DM/GEOG.AW Beowulf – Draft/Draw on pocket bks.	2.15 DT Completing shelters.	PETER STAFF
TUES 9	HIST.AW/GEOG. DM Beowulf Animal References	MATHS Test feedback	LITERACY	PHASE	~~SCIENCE~~ / Music Science VANDALISM (40mins) x2	ICT	PETER
					ICT – Wrapping Paper.		
WED 10	LITERACY	LIT ASS	MATHS Revisiting Division Vocabulary.		LIBRARY/PSHE N/fiction	ART/DT Completing Shelters Art – Masks.	
THURS 11	LITERACY	~~MATHS~~ Music Rm? THEFT x40 mins x2	MUSIC/RE DM – Beowulf – listen, respond to classics.		GAMES	RESEARCH Shelters/Masks.	4 – 5.30 Dolton Univ
FRI 12	MATHS Revisiting Fractions/decimals	PE Dance?	LITERACY		ASS FINISHING OFF		PETER

Computer log – example

Class: **4SL** Week beginning: MAY 8th

Computer Log

Monday	NONE →	B	→	L	GROUP 1 HOUR ANGLO SAXON'S CD.
Tuesday	NONE →	R	→	U	½ CLASS 1 HOUR 20 MINS DAZZLE - WRAPPING PAPER
Wednesday	NONE →	E	→	N	NONE
Thursday	None →	A	→	C	NONE
Friday	None →	K	→	H	Same ½ class 1.20 mins Dazzle Wrapping Paper.

Computer Log.doc

Scenario 1

CS6: Scenario 1

1.30 Mrs Light introduces the task to the whole class in the classroom. She is stood at the front of the class with the children sat at their tables.

The task is going to involve the use of the Anglo Saxons CD.

Initially Mrs Light focuses on explaining to the children how to operate the software (e.g. how to highlight and copy text into the scrapbook).

She then moves on to talk about 'doing research' and to emphasise the importance of the children making judgements about what is important and what they need to copy to their scrapbook. She emphasised that the text that they copied must make sense.

Mrs Light then went through the process briefly:
1st point of decision making is which text to highlight.
When you have all the nuggets of information you can edit them.

1.34 The teacher then explained that this would be a rolling activity and that she didn't expect many of the children to get to do it today.

1.35 Mrs Light warned the children that they would not be able to copy the pictures from the CD but suggested that they might be able to get some from another CD (a Viking picture collection). She said that they should sketch any pictures they were interested in by hand and see if they could find them later on in the library.

1.36 The children then asked questions and the teacher answered them (See Photo 3).

Photo 3 Mrs Light answering children's questions about the Anglo Saxons CD task

1.37 Mrs Light explained the work that the children who were not using the computer would be doing. This related to Beowulf.

1.41 Mrs Light chose three children to work together on the computer.

James sat by the computer. Mrs Light told him to move to let the girls sit by the computer. The computer was already turned on, at the main RM WindowBox Menu screen.

When all the children (2 girls and one boy) were sat by the computer the teacher talked them through the process of loading the program. She explained about how the Anglo Saxons' CD worked and about how to use the scrapbook, re-iterating how the text that they had copied would appear in the scrapbook and that they could then edit it. (see Photo 4)

Photo 4 Mrs Light talking to the children about using the Anglo Saxons CD

1.45 The teacher then went back into the classroom to work with the remainder of the children.

The children started to explore the Anglo Saxons CD.

Tina was controlling the mouse. James was giving instructions about what to do. Louise appeared to be actively reading the text and watching what was happening (see Photo 5).

Photo 5 Tina, Louise and James using the Anglo Saxons CD

The children tried out a number of features, such as magnification of images. They appeared to be reading the blue text on the screen, which contained instructions about clicking on the pictures to find hotspots. The children clicked all over the first picture.

1.49 The children then started to move through the Anglo Saxon CD looking at the available pictures and text. They talked to each other about what they were looking at as illustrated by the brief transcript below:

Tina	What's that? [pointing at a picture of a belt]
James	A belt.

When they looked at the enlarged picture of the Ormside Bowl James said he wanted to draw it. The girls both waited, and then Louise decided that she would draw it as well. James then stopped drawing.

[At this point the researcher conducted an informal interview with Tina. See Transcripts CS6 1.1 and CS6 1.2]

1.56 Louise continued to draw (copy) the picture off the screen. James looked through a book about Anglo Saxons. Tina sat waiting. Tina then went back to the main menu in the Anglo Saxons CD and went to look at a brooch from Sutton. She read the text on screen and then highlighted some of it. Louise carried on drawing.

James then went to fetch the teacher so that she could tell Tina how to copy the text. The teacher came over and explained what Tina needed to do. She then went back into the classroom and Tina copied the text.

2.00 Louise finished her drawing and took over control of the mouse. She tried to do a search but all of her attempts failed to find any matching information.

Mrs Light came over and asked Tina if she had found anything. She pointed at the word 'stag' in the index list on the screen.

Louise entered a new search term (eagle), but again with no success. She asked how you spell eagle and tried it again - no hits. She tried Eagle with a capital E - no hits. She tried 'Stag' - no hits.

Louise "What did they have in those days?"

Tina "Snakes."

Louise tried it - no hits.

Louise "Aaaahhh" [obvious frustration!]

During this time James had been continuing to look in his book. He suggested dragons, and pointed at the information about dragons in his book. The girls ignored him.

2.04 Tina suggested that you needed to close the index before searching. Louise closed the index.

James again suggested searching for dragons.

2.05 Mrs Light came over.

Tina and Louise complained that they couldn't find anything at which point James suggested that they tried searching for dragons. They continued to talk about what to search for and how the search works (or why it has not worked so far). The teacher suggested that they use a different approach, perhaps using the index rather than the search. The children try following some hot links. Mrs Light tells them to read the text as this may help them. They continue exploring for a short while and then return to the search.

2.08 Mrs Light suggests they try searching for Dragons, which they do - no hits. James looks back in his book and then suggests 'oxes', but at this point they abandon the search and return to the index. They follow some hot links (Design Styles - Sutton Hoo Belt - etc).

2.15 Tina suggests that they should let James have a go because otherwise he won't get one. At which point Mrs Light came over and told them that they should spend another 10 minutes locating information and then five minutes editing their notes.

2.16 James took over control of the mouse. Tina went into classroom. Louise carried on doing her drawing (not looking at computer). James read through the text on screen, copying sections as he went. James observed that the audio was not working. Louise finished her drawing and started to pay attention to the computer. Tina returned from the classroom but was not engaging with the computer activity. James continued reading and copying text, he appeared to know his way around the CD. He stops and asks Tina if she has already copied a section of text. She says 'no' and then starts to read the text aloud. She tells James to copy a section. He wants to read it first. Tina wants him to follow a link, but James says he is going to copy all of the text first. Tina agrees. They then move on, looking at the notes attached to pictures. James appears to be trying to make sure that he has looked at all the material in this section of the CD.

2.24 Tina takes over mouse and exits from the Anglo Saxons. She goes into the notebook and tries to print. James wants to read the notes before printing them but Tina says that Mrs Light said just to print them. The printer appears not to work. James scrolls through the text.

Mrs Light comes over and asks if they know how to print. James tells it to print and the teacher warns that it takes a long time to come out. Nothing appears to be happening.

2.26 Mrs Light came back and told the children to get on with other work, while they wait for the printer. They all go into the classroom and the teacher talks to the whole class. She explains that there is an hour to go and that another group can start on the computer today.

2.29 Mrs Light returns to the computer, where there is still no sign of printing. She tries to get it to work and then returns to the classroom.

No other children come out to use the computer during the remainder of the afternoon.

Transcript 1.1

CS6 Transcript 1.1

Who	What
R	So … Tina, what are you trying to do?
Tina	Ehm find out about ehm Anglo Saxon animals
R	About Anglo Saxon animals
Tina	Yeah
R	OK and have you been doing all stuff about Anglo Saxon animals since last week?
Tina	Er No
R	Just
Tina	About two months
R	two months!
Tina	Yea
R	OK and have you used the computer to do this before?
Tina	Yeah
R	Yeah. Dong very much the same sort of thing as this, so you got to got to find out some information and
Tina	Yeah
R	Yeah. Using exactly the same program?
Tina	Yeah
R	Yeah. OK. And do you also use other ways of finding out information besides the computer?
Tina	Err books and … sheets
R	OK

Transcript 1.2

CS6 Transcript 1-2.doc CS6 Transcript 1.2

CS6 Transcript 1.2

Who	What
R	If I if I was to ask you then you know how to use the this program
Tina	Yeahs
R	And you've used it to collect information before
Tina	Yeah
R	Yeah and when you capture the information what do you then have to do cos you're you're going through the Anglo Saxon CD what do you have to do when you've found something that's interesting?
Tina	You, put, put copy it onto the book into your book or put it into the scrap book
R	Into the scrap book, which is what is that a program on the computer the scarp book?
Tina	Yeah
R	Yeah and what do you do with it in the scrap book?
Tina	Er you edit it and then print it
R	You edit it and then print it
Tina	Yeah
R	Now so how do you decide which bits of information you are going to put into the scrap book?
Tina	You have to read it and
R	You read it
Tina	Yeah and share it with your group
R	OK

Scenario 2

CS6 Scenario 2.doc CS6 Scenario 2

CS6: Scenario 2

2.45	Tina using Creative Writer on PC outside 4SL.
	[Researcher talked with Tina as she used the program - see CS6 Transcript 2.1]
	Some other children came over to the computer and joined in. They suggested things that Tina might do and chatted about when they had used the program.
2.55	Children in the classroom finishing off etc
2.56	Tina on Creative Writer - exploring roaming around trying options - particularly taken by person behind shower curtain - looking for his clothes!
2.59	Getting ready for children to go out to play.

See CS6 Transcript 2.2 for a discussion of this activity between the Researcher (R) and Mrs Light (Class Teacher).

Transcript 2.1

CS6 Transcript 2.1

Who	What
R	Tina. OK what are you playing on?
Tina	Er Creative Writing
R	Creative writing
Tina	Yeah
R	Have you been doing that all afternoon?
Tina	No
R	No. What have you been doing most of the afternoon?
Tina	Um been doing stuff for the teacher
R	OK. How long have you been doing this for?
Tina	About ten minutes
R	Right, who was using the computer before you before you
Tina	No one
R	No one Ok
Tina	Cos it wasn't working
R	So did Mrs Wright tell you to use creative writer or did she just say you could do what you want?
Tina	I could use creative writer
R	Ok and what are you using it to do?
Tina	To play on
R	To play on
Tina	Yeah
R	So are you just exploring to see what it can do
Tina	Yeah
R	Have you used it a lot before?
Tina	Well once
R	Once, OK and what did you do with it when you used it before?
Tina	I er took I done some um drawings and some stories that's really it
R	OK so what are you going to do on it today?
Tina	Um I'm just looking at things today
R	What just looking to see what's on it already or looking to see what work is there or looking to see what it can do?
Tina	See what it can do other than writing stories and [?] stories and things like that

Transcript 2.2

CS6 Transcript 2.2

Interview with Mrs Light on 26th May 2000

Who	**What**
R	The one that interests me is the one that I came in and I found Tina playing on at the end of that afternoon
Mrs Light	Oh yes
R	She was working on um I thought I'd printed a sheet out ... Tina
Mrs Light	Yeah
R	Um she was playing on Creative Writer
Mrs Light	Ohh yes, she'd finished her work
R	She'd finished her work
Mrs Light	Yeah
R	So this was a this was a a
Mrs Light	This was definitely er er I've got nothing to do
R	OK
Mrs Light	She'd completed everything and she went the Creative Writer Fine Artist is the one that is permanently in there
R	Right
Mrs Light	Erm for the children to use
R	Right
Mrs Light	I tend to not expect any work out of it [laughs]
R	Right, so you literally say go and use Creative Writer
Mrs Light	Yes yes Do you want to use the computer? Would you like to do this this and this? She said oh I'd like to use the computer f
R	Right
Mrs Light	She went off and erm to some extent some are very very used to it and some are have had very little again and so it was probably
R	Right
Mrs Light	Quite exploratory
R	Any idea how long she spent doing it?
Mrs Light	Oh probably about 20 minutes.
R	20 mins
Mrs Light	Umm
R	Would she have used the program before?
Mrs Light	I think she she would have some access to it yes she would have done that program before
R	She'd have done the program before
Mrs Light	Yeah yeah

R	OK, and what was her task? What was she meant to be doing?
Mrs Light	What her task was I mean varied so to some extent that was self generated
R	Yeah so in a sense we could say not sure because you don't
Mrs Light	No no I don't know she could easily have gone into Fine Artist and created something else yes
R	Actually shall I tell you what she was doing?
Mrs Light	Yes
R	It was very interesting she found this picture of a guy sticking with his head out from behind a shower
Mrs Light	Oh yes
R	And she was intrigued by this picture and found it very funny and she wanted to know what he hadn't got on
Mrs Light	[laughs]
R	She was looking for his underpants
Mrs Light	Oh she [laughs] I think they like that [??]
R	Yes absolutely they were all
Mrs Light	Yes [??]
R	She was searching everywhere I mean she she explored tons of the program it was fascinating stuff
Mrs Light	[laughing]
R	Um yeah very interesting
Mrs Light	[laughs]

Scenario 3

CS6 Scenario 3.doc CS6 Scenario 3

CS6: Scenario 3

2.15 The children had just finished listening to a talk by a visitor to the school about safety.

Mrs Light waited for quiet and then started to introduce the activity. She showed the children a sheet of wrapping paper with gold leaves stamped on it (Photo 6a). She started asking the children questions about the wrapping paper to draw out ideas about repeating patterns. She then introduced a second sample of wrapping paper with pictures of fish on it (Photo 6b) and drew out some distinctions between the two samples (eg only one style of leaf but two styles of fish).

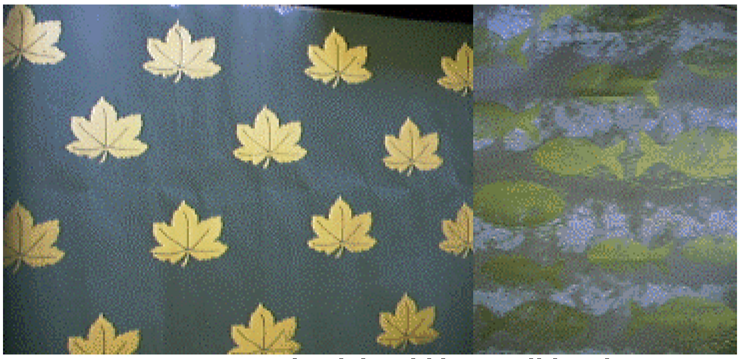


Photo 6 Wrapping paper samples (a) Gold leaves (b) Fish

2.19 Mrs Light then went on to explain that she showing the children the wrapping paper because they were going to use the computers to produce their own wrapping paper. She explained that only half the class would be able to do this activity this time, but that everyone would get a turn.

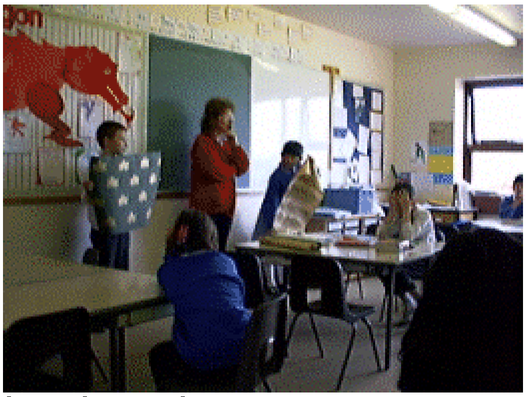


Photo 7 Mrs Light explaining the wrapping paper activity to the class

Page 1 of 4

2.24 Mrs Light then reviewed some of the ways in which they had used computers in the past and specifically mentioned their 'Roman Time Line' and 'moving things around in Word'. She explained that they were going to use a paint type package today called ? (Dazzle) [Mrs Light couldn't remember the name of the program at this point].

She said that the children would need to take their won chairs with them when they went to work on the computers. She then explained the sequence of steps that they would need to go through to load the program (log on as pupil - main menu - Dazzle[1] - then wait).

The teacher then organised what work each child/group would be doing:

- Those who used the computer yesterday would work on Beowulf today.
- 3 children to work on the computer outside the classroom using the Anglo Saxons CD. Finding information about kings.
- Pairs of children (named in turn) to work on wrapping paper designs on computers. [12 girls and 2 boys working in single gender pairs]
- Rest to work on Beowulf in the classroom.

2.29 The children who were working on the wrapping paper started to move to the computers, but then came back to say that there were people on the computers already. Mrs Light went to find out what was going on. [The Yr5 class was using the computer network - they had forgotten that the timetable for using the network had changed at the beginning of the term]

The children from 4SL waited in a line until they could go to their computers (Photo 8).

Photo 8 Children from 4SL waiting to use the peer-to-peer network

[1] This is not the correct sequence. It should be: log on - main menu - Painting & Drawing - Dazzle.

2.33 As the children settled down at their computers Mrs Light helped them to log on and load Dazzle (Photo 9).

Photo 9 Mrs Light helping children to log on and load Dazzle

2.35 As the software loaded the children started to explore its features.

Mrs Light called the children to gather around one machine. She then explained how to load stamps into Dazzle (Photo 10) and explained that the children had to decide which stamp to use to make their wrapping paper. She went through various features of stamps (eg resizing) and responded to children's questions about how to use the software (eg How do you get rid of a stamp?).

Photo 10 Mrs Light explaining how to load stamps into Dazzle

2.37 The children then returned to their own machines and the teacher circulated helping pairs of children load the stamps and work out how to use them. It took approximately 3 minutes for all the children to load the stamps and start to experiment with them.

2.40 The teacher then returned to the classroom to check on the other half of the class. The children carried on experimenting with the stamps and other features of Dazzle.

[The researcher spent some time informally interviewing pairs of children about what they were doing etc. See CS6 Transcript 3.1]

2.48 Mrs Light returned and went to help a pair of children who were having problems with the computer. The teacher logged them back into the system. She then continued to circulate helping children, mainly with issues to do with how to operate the software.

2.55 One of the computers crashed and the researcher was asked to sort it out by the teacher while she continued to circulate.

2.57 Mrs Light tried to show a pair of children how to re-size stamps but had difficulties doing it. [This appeared to be related to a problem with Dazzle - stamps can be resized by scrolling in the size box, but if the number gets very big then they scroll very slowly - as they are buffered they keep going even when you have stopped clicking]

2.59 Mrs Light asked the researcher how to scroll within the in Dazzle window. [There were no scroll bars on screen which appears to be due to the program defaulting to a page the size of a screen - ie there is no need for scroll bars]

3.00 Mrs Light told the children that they needed to stop what they were doing and think about saving their work. She talked them through how to save their pictures. Some of the pairs of children followed along as she gave these instructions, others did not.

3.02 The teacher then moved around the machines, showing the children how to save their work. [The printer had run out of ink so the children could not print their pictures]

3.07 Mrs Light helped the pair of boys save their work. She told all the children to exit from the program. The teacher then went back into the classroom.

3.09 Mrs Light returned to the peer-to-peer network and explained to a pair of girls about how to save changes to their picture. Most of the children are either clearing away or have already returned to the classroom.

See CS6 Transcript 3.2 for a discussion of this activity between the Researcher (R) and Mrs Light (Class Teacher).

Transcript 3.1

CS6 Transcript 3.1

Informal interview with Sarah and Carol on 9th May

Who	**What**
R	Right, so it's recording now. Can you tell me what your names are?
Sarah	Sarah
R	Sarah
Sarah	And Carol
R	And Carol. OK. Can you tell me what you're doing?
Sarah	We're making a wallpaper.
R	You're making wallpaper. OK, and how are you doing that?
Sarah	We're choosing a stamp, and we're going to bring chose the size and then bring it onto the page.
R	OK. Have you used this program before?
Sarah & Carol	No
R	Never? Have you used these machines before...these computers?
Sarah	Yes
R	Yeah. When did you last use them?
Carol	In year 3.
R	In year 3. So Sarah have you used them more recently than that?
Sarah	Yeah. In year 4.
R	In year 4...you're in year 4 now aren't you?
Sarah	Yeah
R	But you haven't used them before in this class
Carol	No
R	But you have
Sarah	Yes
R	Ok, so when did you last use them?

Transcript 3.2

CS6 Transcript 3.2

Interview with Mrs Light on 9th May

Who	**What**
R	Tell me, if I was to ask you how much of your time or how much of the kids time you think they were spending there learning about patterns and thinking about patterns and how much time spending learning to use the computer what what would you say
Mrs Light	I think the majority was learning to use the computer exploring what they had to offer
R	Right
Mrs Light	rather than specific details of creating patterns.
R	Ok
Mrs Light	Because I think it is rare, unless you've got that ??[vacuum cleaner in the background!] you've got passed thinking 'Ooh look this looks interesting'
R	Yeah
Mrs Light	Then then you really the process is very difficult for them to stay on.
R	Yeah
Mrs Light	They know what they have to do,
R	Yup
Mrs Light	but the actual material chance of getting on and do it was just too too they really want to play
R	Yeah yeah
Mrs Light	and I really would love them to play and play and play ..
R	Yeah
Mrs Light	but that becomes then important to them...the ones like um Tim,
R	Yeah
Mrs Light	He would not have a problem because he's so into it at home
R	Yeah
Mrs Light	That he'd just say 'Oh this is pretty straightforward I'll do it'
R	OK

Mrs Light	And he goes and works with someone.
R	Right
Mrs Light	It doesn't become an issue then whereas ?? [hover noise] depending on low experience. I mean Mayling probably hasn't even got a computer at home
R	Right
Mrs Light	So it's more of an issue
R	The two at the end…the two boys, they didn't want to go on, it that right?
Mrs Light	No. 'I don't want to do it I don't want to do it'. Yet I actually thing they got an awful lot out of it.
R	Right
Mrs Light	In the fact that they found things that that we I think the nice thing about exploring is that children are discovering it for themselves. [hover noise drowned out next few words]
R	Yeah
Mrs Light	They can go off and can explore and he found that you could divide it in four. Whatever you did there reproduced itself
R	Yeah
Mrs Light	Which is ideal for making patterns.
R	Yeah
Mrs Light	And it was superb
R	And which we didn't know
Mrs Light	Yes that's right yes [both laugh] and its great and oh well that's one bit sorted. And so it's just really the shear fact that they had the opportunity to
R	Do you think they will get a chance to go on and play with patterns more now they've learnt to play with the package?
Mrs Light	Yeah I think so, I think next time they will be much more focused on what they have to do, and then of course I'll have to have the other group in to go through the play stage and then hopefully they'll accomplish something. What tends to what can happen though is next time they started with something and they don't know when to stop.
R	Yeah
Mrs Light	Which in any art activity can have that potential

R Yeah

Mrs Light So they'll start doing something really well and they'll say 'That's really nice I think you should [background noise blocked out next two words]' and they do and I think then then they'll save that

R Yeah and they wipe out something that's really nice.

Mrs Light Really good.

R Yeah. That actually happened to a couple this afternoon. They

Mrs Light Yeah

R Had some really nice things

Mrs Light Yes and I think its I find it really interesting that they were putting backgrounds on that were 999%

R Yeah

Mrs Light And not understanding why it crashed. They hadn't yet got the idea that that it was a window on a bigger picture

R Yeah

Mrs Light That they were multiplying

R Yeah

Mrs Light So the actual application was still going on and they were ?? [few words drowned out by vacuum cleaner]

R Yeah

Mrs Light And so I think that's something I have to go back and revisit. The idea the idea that it's it's actually a window on something

R Yeah

Mrs Light and using that analogy because any computer wouldn't cope with that so

R Why did you choose to do patterns today rather than something else?

Mrs Light Because it was in the QCA document

R Because its in the QCA document, fine Ok

Mrs Light Yeah basically. The id I thought it was accessible,

R Yeah

Mrs Light because I knew I could start with something concrete

R Yeah

Mrs Light	OK, with discussion of wrapping paper
R	Patterns - yeah I need to take a photo of those.
Mrs Light	Yeah
R	Laughs
Mrs Light	And move it on. Um and then it was something that originally it was going to use cut and paste, it suggested cut and paste, which I knew they'd done so I was re-visiting something they'd done in the autumn term
R	Yeah
Mrs Light	And I felt that was valuable and also it it was something you could achieve
R	Yeah
Mrs Light	in a relatively short time.
R	Would it be fair to say then that that the afternoons when you have seven machines, you focus very much in on QCA type things which are very much about learning about IT...
Mrs Light	Yes
R	and that for example your Anglo-Saxons is much more about using the computers as a tool to help you with other stuff?
Mrs Light	Absolutely, yes. Yes. I would like to have the opportunity to do both
R	Yeah
Mrs Light	But of course I only have one slot,
R	Yeah
Mrs Light	I only have half an afternoon, unfortunately
R	Yeah right
Mrs Light	an hour a week on those computers [the network of seven machines], and that's that's really where I can deliver most ICT. In the initial ICT which was uhm...the QCA document enabled me to use the pocket book,
R	Right
Mrs Light	where I had one week on pocket books and one week on big computer,
R	Yeah
Mrs Light	which was very good because I could do a lot of the ground work

R Yeah

Mrs Light and I could maybe use that [pocket books] more often if nobody was using them

R Right

Mrs Light and then finish off on the big computers. But unfortunately with patterns that isn't something I can do. [2 seconds blocked out by vacuum cleaner]

R Right

Mrs Light So it's very much geared up to delivering QCA

R Fine

Mrs Light And and I think this year for all the QCA documents we've really been lead by the nose to some extent.

R Yeah

Mrs Light And in ICT we needed to be lead. Next year I think I'll say well actually if I go back to what the ICT curriculum says, why

R Yeah

Mrs Light well you know I think I can do that in a better way.

<Talk about NOF training omitted from here>

R You deliberately have chosen single gender groups, is that…

Mrs Light No, I didn't.

R You didn't?

Mrs Light No,

R You've just got an awful lot of girls in the classroom.

Mrs Light I've got an awful lot of girls yes, and I knew which boys I didn't want there,

R Right

Mrs Light and I knew that there was four that had gone on computers yesterday

R Right

Mrs Light So I thought of that and another group was going on that computer [to work on the Anglo Saxon's CD]

R Yeah

Mrs Light So that basically meant pairs

R	Right
Mrs Light	I suppose I could have mixed them but I didn't do it deliberately. I think I did more friendship which I thought ?? [drowned out by background noise]
R	Right Ok
Mrs Light	Friendship units rather than
R	Yeah
Mrs Light	It it does work uh there is still a female tension, I mean you saw that less yesterday because there was one boy and two girls and James it's a different culture
R	Yeah
Mrs Light	Surrounded by women. Here two boys straight together and the girl's were peripheral
R	Yeah
Mrs Light	And that I'm very still aware that that is an issue
R	Yeah
Mrs Light	And you have to say 'make sure you '
R	Yeah well I noticed at the beginning you saying that they all had to have a go with the mouse
Mrs Light	Yeah um yeah it becomes .. a bit like the old blipper at home on the TV
R	Laughs

<Rounding up talk>

Appendix O
Reliability testing response sheets

Response sheet.doc Response sheet

Response sheet

1 Scenario 1

Question 1.1: For how much time (in minutes) were computers being used in Scenario 1? (Refer to Page 3 of the instructions for a reminder of the definition of quantity of computer use)

Quantity of computer use [   ] mins

Question 1.2: Rate the relative weighting of each possible Focus of the computer use implemented in Scenario 1 as percentages. (Refer to Pages 2 & 3 of the instructions for a reminder of the definition of each possible Focus)

IT		%
Learning Tool		%
Other		%
Total	100	%

Please explain the reasoning behind these weightings:

Question 1.3: Indicate how far along the Mode scale the computer use implemented in Scenario 1 reached. (Refer to Page 4 of the instructions for a reminder of how to work out the Mode)

Support Extend Transform

Please explain the reasoning behind your decision about Mode of computer use:

Page 1 of 5

2 Scenario 2

Question 2.1: For how much time (in minutes) were computers being used in Scenario 2? (Refer to Page 3 of the instructions for a reminder of the definition of quantity of computer use)

Quantity of computer use		mins

Question 2.2: Rate the relative weighting of each possible Focus of the computer use implemented in Scenario 1 as percentages. (Refer to Pages 2 & 3 of the instructions for a reminder of the definition of each possible Focus)

IT		%
Learning Tool		%
Other		%
Total	100	%

Please explain the reasoning behind these weightings:

Question 2.3: Indicate the Mode of computer use implemented in Scenario 1. (Refer to Page 4 of the instructions for a reminder of how to work out the Mode)

Support Extend Transform

Please explain the reasoning behind your decision about Mode of computer use:

3 Scenario 3

Question 3.1: For how much time (in minutes) were computers being used in Scenario 1? (Refer to Page 3 of the instructions for a reminder of the definition of quantity of computer use)

Quantity of computer use		mins

Question 3.2: Rate the relative weighting of each possible Focus of the computer use implemented in Scenario 1 as percentages. (Refer to Pages 2 & 3 of the instructions for a reminder of the definition of each possible Focus)

IT		%
Learning Tool		%
Other		%
Total	100	%

Please explain the reasoning behind these weightings:

Question 3.3: Indicate the Mode of computer use implemented in Scenario 1. (Refer to Page 4 of the instructions for a reminder of how to work out the Mode)

Support Extend Transform

Please explain the reasoning behind your decision about Mode of computer use:

Response sheet.doc | Response sheet

4 Overall

Question 4.1: On average, for how much time (in minutes per week) were computers being used in this classroom during the summer term? (Refer to Page 3 of the instructions for a reminder of the definition of quantity of computer use)

Average quantity of computer use [ ] mins/week

Question 4.2: Rate the relative weighting of each possible Focus of the computer use implemented in this classroom over the summer term as percentages. (Refer to Pages 2 & 3 of the instructions for a reminder of the definition of each possible Focus)

IT		%
Learning Tool		%
Other		%
Total	100	%

Please explain the reasoning behind these weightings:

Question 4.3: Rate the relative weighting of each possible Mode of computer use implemented in this classroom over the summer term as percentages. (Refer to Page 4 of the instructions for a reminder of how to work out the Mode)

Support		%
Extend		%
Transform		%
Total	100	%

Please explain the reasoning behind these weightings:

Page 4 of 5

5 Info re respondent

Question 5.1: What is your 'phase' of education?

Early Years Primary Secondary

Other – please specify:

Question 5.2: What is your subject specialism?

Question 5.3: Are you happy for me to come back to you for further information/clarification of any points in your response that I do not understand?

Yes No

If the answer to 5.3 is Yes - what is your email address?

Question 5.4: Are there any comments/observations/criticisms that you would like to make re the CPF? (If there are please do so below - or feel free to email me).

Appendix P
Reliability testing statistics

	Category		N=3		
Scenario	**Support**	**Extend**	**Transform**	***k***	***S***
1	17	2	1	20	0.721053
2	8	3	9	20	0.352632
3	6	9	5	20	0.321053
Cj	31	14	15		
pj	0.5166667	0.233333	0.25		
P(E)=	0.3838889				
P(A)=	0.4649123				
K=	0.132				

Appendix Q
Uptake of the Computer Practice Framework

The following people have contacted the researcher to express an interest in using the CPF. These were all unsolicited approaches.

- An academic in the UK who is linked with a Local Educational Authority, which is interested in using the CPF to support their development planning.

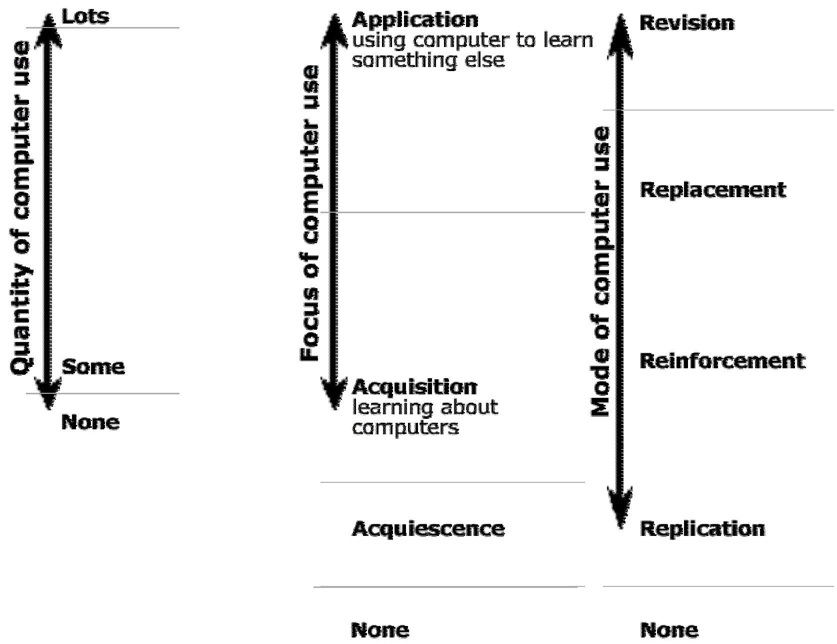
- The Head of IT and Infrastructure Manager for the London Grid for Learning, who wants to use the CPF to inform their planning and practice.

- The director of the Research Centre at the Iceland University of Education, who wants to use the CPF "to provide a coherent base for discussing what is actually going on with ICT in education".

- The editor of Information Transfer (IT), the journal of the New South Wales Computer Education Group, who wants to publicise the CPF website to the journal's readership, which is mainly comprised of teachers.

Appendix R
Summary of versions of the Computer Practice Framework

Version	Description	Page
CPF v1		217 to 227



Quantity: the amount of computer use. Fuzzy scale (None, Some, Lots). 217

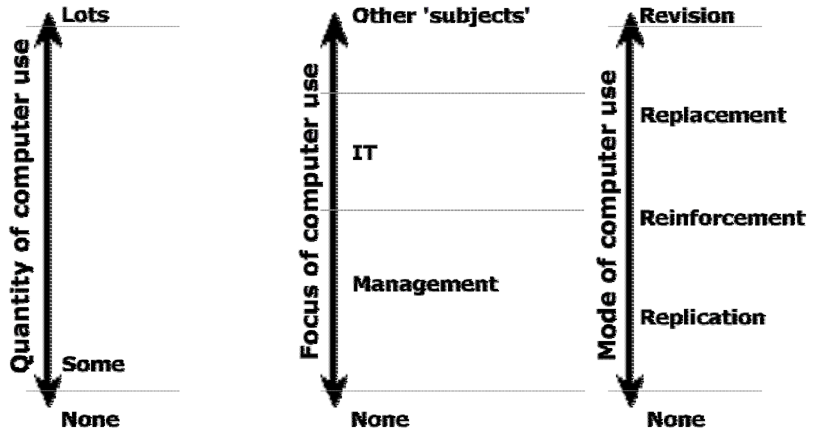
Focus: the reasons underpinning computer use. Select the most significant, in the sense of predominating category. 221

Category	Definition
None	Quantity of computer use is 'None'
Acquiescence	Using the computer in order to comply with external pressures
Acquisition	Using the computer in order to learn about the technology
Application	Using the computer as a tool to support learning about something else

Mode: the ways in which computers are used. Select the category that applies that is furthest from the None end of the dimension. 225

Category	Definition
None	Quantity of computer use is 'None'
Replication	Using the computer to repeat work that has already done 'by hand'
Reinforcement	Using the computer to reinforce knowledge/skills which have already been acquired
Replacement	Using the computer to replace work that they could have done without a computer

CPF v2

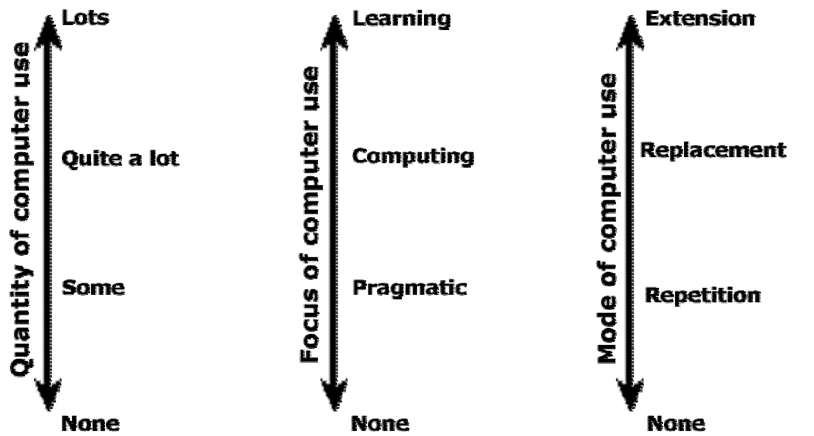


Quantity: as version 1
Focus: 234

Category	Definition
None	Quantity of computer use is 'None'
'Management'	The aim is organisational or managerial rather than primarily educational
IT	The focus is on learning about computers
Other 'subjects'	Using or applying your computer skills to do something else

Mode: as version 1

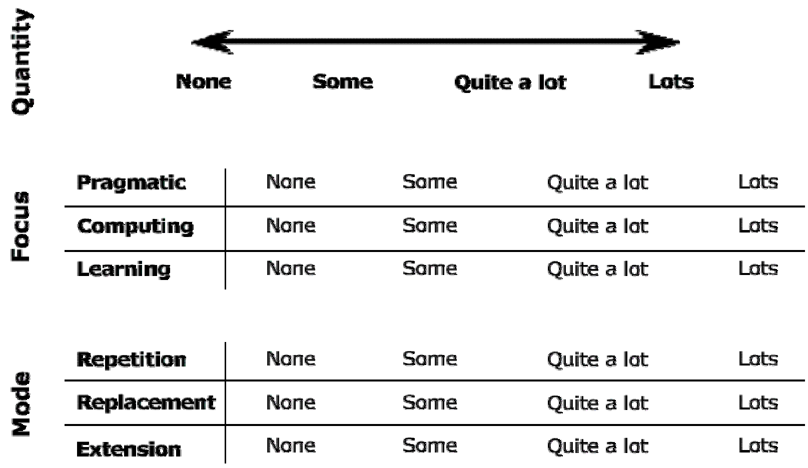
CPF v3 235 to 236



Quantity: new category – Quite a lot – added.
Focus: Category labels changed, definitions remained as in version 2. 235
Mode: How computer use is actually implemented. 235

Category	Definition
None	Quantity of computer use is 'None'
Repetition	Computer used to repeat an activity which the user can already do
Replacement	The activity on the computer replaces an activity that would otherwise have been done in some other way
Extension	Computer use alters what the children learn or the way in which they learn it

CPF v4 241 to 242

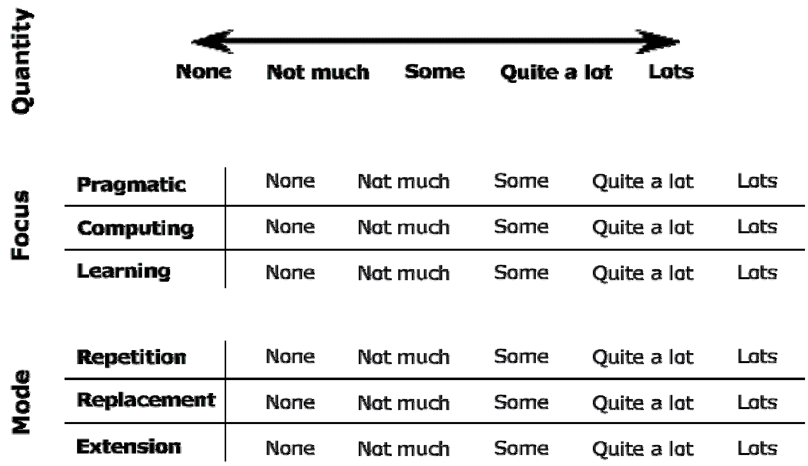


Quantity: definitions of fuzzy terms mapped onto minutes per day. 242

Focus: use of fuzzy descriptors to say the relative extent to which each category applies. Definitions of fuzzy terms mapped onto percentages to which each category applies. 241 to 242

Mode: use of fuzzy descriptors to say the relative extent to which each category applies. Definitions of fuzzy terms mapped onto percentages to which each category applies. 241 to 242

CPF v5 287 to 288



Quantity: fuzzy descriptor – Not much – added.

Focus: fuzzy descriptor – Not much – added.

Mode: how the computer is actually used. Fuzzy descriptor – Not much – added. 287

Category	Definition
None	Quantity of computer use is 'None'
Repetition	Where the computer is being used to repeat something which the user already knows/understands/can do (either on or off the computer)
Replacement	Where the computer is being used to do something which the user has not done before (either on or off the computer) but which could have been done without a computer
Extension	Computer use alters what the children learn or the way in which they learn it

CPF v6

Quantity: as version 5. 293

Focus: 294

Category	Definition
IT	Using computers in order to learn about computers
ICT	Using computers as tools to help children learn about something else
Other	Using the computer for some other reason
N/A	Quantity of computer use is 'None'

Mode: 293

Category	Definition
None	Quantity of computer use is 'None'
Repetition	Where the computer is being used to repeat something which the user already knows/understands/can do (either on or off the computer).
Replacement	Where the computer is being used to do something which the user has not done before (either on or off the computer) but which could have been done without a computer.
Extension	The activity on the computer enables you to do something which extends the curriculum or pedagogy, but which would have been seen as being valuable without a computer (but would not have been practically possible without a computer)
Transformation	The activity on the computer enables you to do something which extends the curriculum or pedagogy that you could not and/or would not have done if it were not for computers.

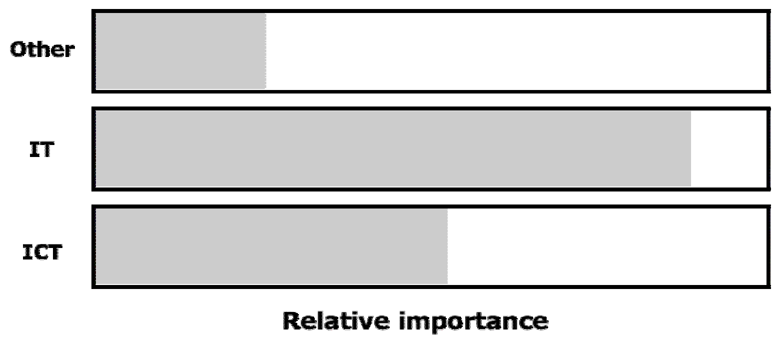
CPF v7 (as presented to teachers)

Quantity: How much of the school day one or more computers are in use by children from your class. Within this definition, the school day is taken to mean time when children are in school but excluding play times, lunch times, after school clubs etc. The number of children using a computer is irrelevant (for this indicator), as is the number of computers in use. If a computer is being used with children, even if they are not controlling the keys/mouse, that counts as it being used by the children. 297

Focus: deals with the reasons why you use a computer with your children. The Focus dimension does not apply if you are not using computers with your children (i.e. if the Quantity of computer use is 0%). 297 to 298

Category	Definition
IT	Using computers in order to *learn about computers.* Thus the focus here is on using a computer in order to extend the children's knowledge, understanding or skill in computer use. E.g. Using the computer in order to learn how to operate the mouse. E.g. Using the computer in order to learn how to use the word processing software.
ICT	Using computers as tools to help children *learn about something else*. E.g. To help them develop the language skills involved in drafting and re-drafting. E.g. To extend their ability to interpret graphs (i.e. mathematics).
Other	Using the computer for *some other reason*. Reasons for using computers that fall within this category are not focused on learning but on some other aspect of the classroom situation. E.g. Using IT in order to be seen to be using it. E.g. Allowing children to use the computer as a reward or filler activity.

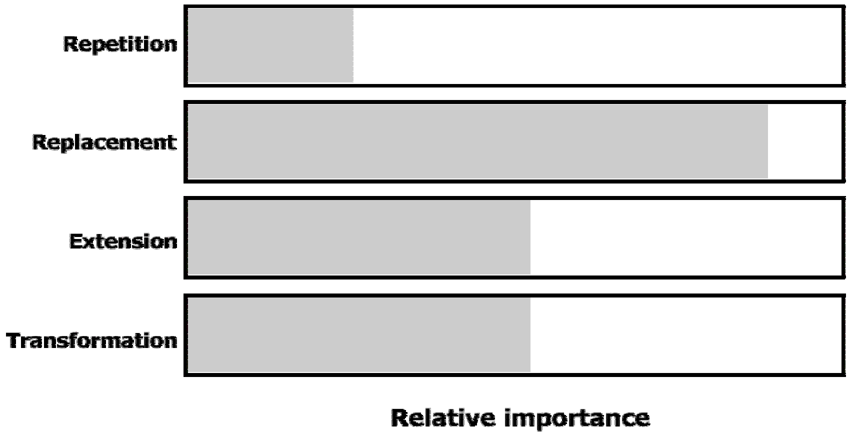
All three categories on the Focus dimensions may apply at any one time. The key is to identify the relative importance of each category:



Mode: how computers are used in your class. The Mode dimension does not apply if you are not using computers with your children (i.e. if the Quantity of computer use is 0%). 298 to 300

Category	Definition
Repetition	Where the computer is being used to repeat something which the students already 'know/understand/can do' (either on or off the computer). i.e. The students are repeating an activity that they have done before (though the context previously may not have been on the computer). E.g. Generating graphical representations of data when the students already know how to draw such representations by hand. E.g. Generating graphical representations of data when the students have already learnt how to draw such representations on the computer (even if they do not know how to draw them by hand).
Replacement	Where the computer is being used to do something which the students have not done before (either on or off the computer) and which could have been done without a computer. E.g. Learning how to carry out a statistical analysis on the computer (when they have never learnt how to do this before either on or off the computer).
Extension	Where the computer is being used to do something which extends the curriculum or pedagogy within the classroom but which would have been seen as being valuable without computers. i.e. you are doing something that would not have been practically possible within the classroom without a computer but which would have been valued as part of practice if it were possible. E.g. Writing for a real audience in another country (using email). E.g. Having an ongoing discussion with remote experts (via computer conferencing). E.g. Using a simulation to explore 'being' a racing driver or an underwater archaeologist.
Transformation	Where the computer is transforming the curriculum or pedagogy. i.e. you are doing something that extends the curriculum and/or pedagogy that you could not and/or would not have done if it were not for computers. E.g. Increasing the literacy skills that children deal with to include understanding multimedia 'texts'. E.g. Explicitly teaching the children how to teach each other (if this is something that you would not have previously done in any other context).

Whilst for any one activity one Mode is likely to predominate, over a series of activities all four categories on the Mode dimensions may apply to some degree. The key is to identify the relative importance of each category:



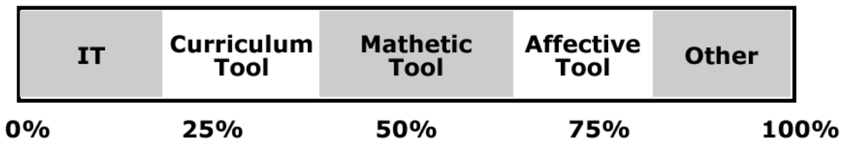
CPF v8 (as presented to teachers)

Quantity: as version 7. 303

Focus: 303 to 305

Category	New definition
IT	Using computers in order to help children to develop their IT skills, knowledge and understanding. The emphasis here is on using a computer in order to extend the children's knowledge, understanding or skill in computer use itself.
Curriculum Tool	Using computers as tools to help children to develop skills, knowledge and understanding in another curriculum area. The emphasis here is on using the computer as a tool to enhance their learning in another curriculum area rather than in the area of IT itself.
Mathetic Tool	Using computers as tools to develop children's ability to learn and enhance their approaches to learning.
Affective Tool	Using computers as tools to support and enhance the affective aspects of children's learning.
Other	Using the computer for some other reason. Reasons for using computers that fall within this category may be focussed on practical aspects of the learning situation or the larger context in which the computer use is taking place.

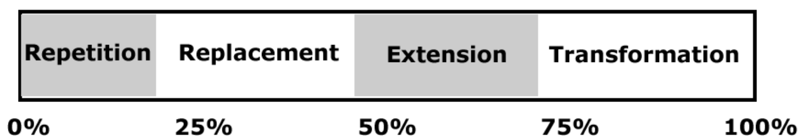
Represented as:



Mode: 305 to 306

Category	New definition
Repetition	Where the computer is being used to repeat something which the children already 'know/understand/can do' (either on or off the computer). i.e. The children are repeating an activity that they have done before (though the context previously may not have been on the computer).
Replacement	Where the computer is being used to do something which the children have not done before (either on or off the computer) and which could have been done without a computer.
Extension	Where the computer is being used to do something which extends the curriculum or pedagogy within the classroom. i.e. the teacher (or her children) is doing something that they **would not** have done if it were not for computers.
Transformation	Where the computer is transforming the curriculum or pedagogy. i.e. the teacher (or her children) is doing something that extends the curriculum and/or pedagogy that they **could not** have done if it were not for computers.

Represented as:



CPF v9 (as presented to teachers)

Quantity: as version 7. 303

Focus: categories simplified (but definitions of subcategories remained unchanged). 303 to 305

Previous Category	New Category	Sub-categories
IT	IT	None
Curriculum Tool		Curriculum Tool
Mathetic Tool	Learning Tool	Mathetic Tool
Affective Tool		Affective Tool
Other	Other	None

Mode: as version 8. 305 to 306

CPF v10 (as presented to teachers)

Quantity: redefined: 316

In order to work out the Quantity of computer use you need to calculate the number of minutes during which one or more computers are used by one or more children during the school day. In doing this calculation:

- The school day is taken to mean time when children are in school but excludes play times, lunch times, after school clubs, etc;
- If a computer is being used with children (even if they are not controlling the keys/mouse) that counts as it being used by the children.

Focus: deals with the objectives that the computer use sustains, when it is implemented. 303 to 305

Category	New definition
IT	**Using computers in a way that helps children to develop their ICT skills, knowledge and understanding.** The emphasis here is on using a computer to extend the children's knowledge, understanding or skill in computer use itself.
Learning Tool	**Using computers in a way that supports any aspect of children's learning other than ICT itself.** This would include the following three areas: *Curriculum Tool* - Using computers as tools in a way that helps children to develop skills, knowledge and understanding in another curriculum area (i.e. other than ICT). The emphasis here is on using the computer as a tool to enhance their learning in another curriculum area rather than in the area of IT itself. *Mathetic Tool* - Using computers as tools to develop children's ability to learn and enhance their approaches to learning. *Affective Tool* - Using computers as tools to support and enhance the affective aspects of children's learning.
Other	**Using the computer for some other reason (i.e. not covered by *IT* or *Learning Tool*).** Reasons for using computers that fall within this category may be focussed on practical aspects of the learning situation or the larger context in which the computer use is taking place.

At any one time all three foci always apply to some degree. The key to the Focus dimension is the relative extent to which each of these three aspects applies.

It is important when thinking about the Focus to distinguish between what a teacher would like the objectives to be, what she plans the objectives to be, and what they are when the activity is implemented. **The Focus (and indeed the whole of the CPF) is concerned with what actually happens when a computer is used, not what was intended.**

The Focus of use will alter over time, even within the same activity. Thus, when deciding on the relative weighting of each of the aspects on the Focus dimension you have to **take an average weighting over the time period that you are interested in**.

Mode: deals with 'the impact that computer use had on the curriculum' where curriculum was taken to include both the content and processes of learning. 317 to 319

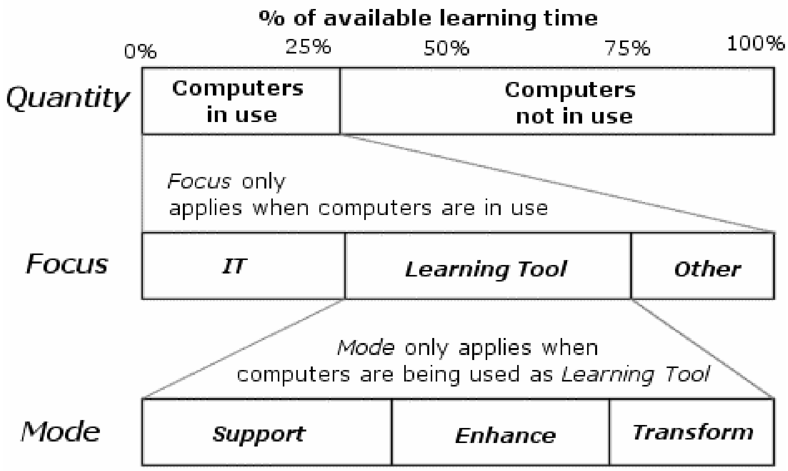
	Curriculum: Content (Learning objectives ignoring ICT objectives)		Curriculum: Process (How they learn)	Summary
Support	Same	and	automated but otherwise essentially unchanged	More efficient or effective without changing content
Extend	Different - but does not require a computer	and/ or	different - but does not require a computer	Changes content and/or process but could have been achieved in a 'classroom' without a computer
Transform	Different and requires a computer	and/ or	different and requires a computer	Changes content and/or process and could not have been achieved in a 'classroom' without a computer

Questions also devised to help identify which Mode applies:

		Answer = No	Answer = Yes
1	Has *what* the children are learning changed?	Go to 2	Go to 3
2	Is automation the only change to the *process* through which the children learn in this activity?	Go to 3	Mode is Support
3	Could you do this in a school context without a computer?	Mode is Transform	Mode is Extend

In order to calculate the Mode over a period of time tae the average across each instance of computer use.

CPF v11 (as presented to teachers) 345



Quantity: as version 10. 316

Focus: deals with the objectives underlying the computer use. 343 to 344

Category	New definition
IT	**Using computers in a way that helps children to develop their IT[1] skills, knowledge and understanding.** The emphasis here is on using a computer to extend the children's knowledge, understanding or skill in computer use itself. E.g. Learning how to operate the mouse. Learning how to use the word processing software.
Learning Tool	**Using computers in a way that supports any aspect of children's learning other than *IT* itself.** This would include the following three areas: *Curriculum Tool* - Using computers as tools in a way that helps children to develop skills, knowledge and understanding in another curriculum area (i.e. other than IT). The emphasis here is on using the computer as a tool to enhance their learning in another curriculum area rather than in the area of IT itself. E.g. To develop the language skills involved in drafting and re-drafting. To extend their ability to interpret data (e.g. using a graphing package that they already know how to operate to help them answer a scientific question). To provide access to the curriculum (e.g. for children with 'Special Needs'). *Mathetic Tool* - Using computers as tools to develop children's ability to learn and enhance their approaches to learning. E.g. To encourage collaboration. To help children reflect on their own learning processes. To teach children to teach each other how to use particular programs. *Affective Tool* - Using computers as tools to support and enhance the affective aspects of children's learning. E.g. To develop their confidence and/or self-esteem (for example by allowing a child who may be perceived as 'less able' to teach other children how to use a new program). Using computers to help motivate children.
Other	**Using the computer in a way that is not covered by *IT* or *Learning Tool*.** *Other* thus includes objectives that do not relate directly to learning outcomes and/or where no learning is apparent. Objectives for using computers that fall within this category may be focussed on practical aspects of the learning situation or the larger context in which the computer use is taking place. E.g. Using computers in order to respond to pressure to do so from children, their parents, colleagues and/or external agencies. Allowing children to use the computer as a reward or holding activity whilst the teacher is working elsewhere. An example of this would be allowing children who have finished other work to 'go on the computer'. Using a computer in order to make the teacher's workload or classroom management easier or more enjoyable. Using computers as a mechanism for presenting the school in a good light or in order to be seen to be using them. *Other* would apply where no learning is evident.

Mode: concerned with the impact of computer use on the curriculum. The curriculum is taken here to cover all aspects of practice surrounding computer use including: 344 to 345

- content (which incorporates and goes beyond the explicit curriculum as set down in guidelines/curriculum documents but omits the *IT* curriculum - i.e. excluding aspects dealing with how to operate the computer/software);
- processes.

The Mode only applies where the Focus of an activity is Learning Tool.

Category	Definition
Support	Learning objectives (excluding those relating specifically to *IT*) remain the same but the process is automated in some way. *Support* is thus about improving efficiency and effectiveness without changing curriculum content.
Extend	Curriculum content and/or process are different, but these changes *could* take place in a classroom context *without* a computer.
Transform	Curriculum content and/or process are different, and these changes *could not* have taken place in a classroom context *without* a computer.

CPF v12

346 to 350

As version 11, but identifies the need to distinguish between aspirations, intentions and what is achieved for each of the three dimensions. This in turn lead to a change in the way in which the CPF should be used: moving away from using it as a framework for describing practice and towards a conceptual framework to support thinking about computer use.